DOCUMENT RESUME

ED 216 129	CE 032 082
AUTHOR	Butler, Raymond H.; And Others
TITLE	Mechanical Technology. Post Secondary Curriculum Guide.
INSTITUTION	Georgia Univ., Athens. Div. of Vocational Education.
SPONS AGENCY	Georgia State Dept. of Education, Atlanta. Office of Adult and Vocational Education.
PUB DATE	81
NOTE	654p.
EDRS PRICE	MF03/PC27 Plus Postage.
DESCRIPTORS	Behavioral Objectives; Competence; Course Descriptions; Definitions; Educational Facilities; Educational Objectives; Educational Philosophy; Employment Potential; Guidelines; *Instructional Development; Instructional Materials; Job Skills; Learning Activities; Learning Laboratories; Learning Resources Centers; *Mechanical Equipment; Mechanical Skills; Models; Occupational Information; Postsecondary Education; Records (Forms); Resources; State Curriculum Guides; Student Evaluation; *Technical Education; Vocational Education
IDENTIFIERS	*Mechanical Technology; *Special Needs Students

ABSTRACT

This curriculum guide is designed to offer guidelines along with supporting resources and teaching ideas from which the local postsecondary vocational instructor can extract a mechanical technology curriculum that meets local needs. Following an outline of the philosophy and goals underlying state and local vocational education programs in Georgia, the purpose and objectives of the guide are explained. Covered next are the nature and scope of the field of mechanical technoloby, employability skills that are necessary in the field, student exit points, and tasks performed in various job classifications. A sample curriculum structure and a course outline are provided. The bulk of the guide consists of a series of unit guides, each of which contains a task statement, a performance objective, instructional activities, suggested instructional materials, and evaluation criteria. The next two sections consist of listings of course-related references and resources and student record forms. Suggestions are set forth for working with special needs students. Also included are facility layouts for a learning laboratory and a learning resource center. (MN)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

8113 303

MECHANICAL TECHNOLOGY

ED216129

Post Secondary

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)

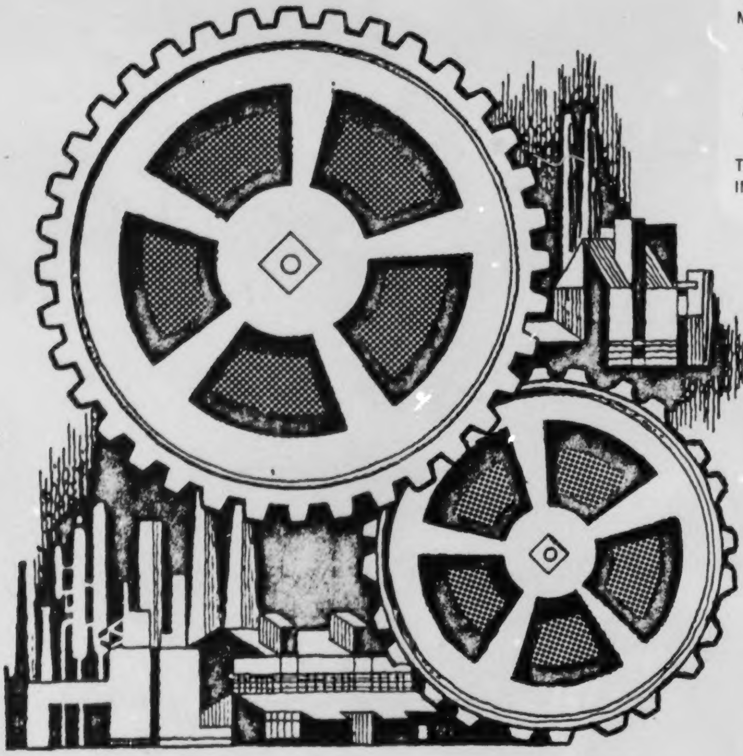
✓ This document has been reproduced as received from the person or organization originating it.
Minor changes have been made to improve reproduction quality.

- Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

A. Maughon

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."



CE 032 082

CURRICULUM GUIDE

Georgia Department of Education

MECHANICAL TECHNOLOGY

Developed Under Contractual Agreement with

Division of Program Development
Office of Vocational Education
Georgia Department of Education
Atlanta, Georgia 30334
Charles McDaniel, State Superintendent of Schools
1981

MECHANICAL TECHNOLOGY

Developed By

The University of Georgia

Under the Direction of

Dr. Paul Scott

Vocational Education Materials Center

Division of Vocational Education

College of Education

Dr. George L. O'Kelley, Jr.

Division Chairman

MECHANICAL TECHNOLOGY

Raymond H. Butler, Mechanical Technology Series

DEVELOPERS

Raymond H. Butler	Principal Developer
A. R. Adair	Technical Writer
G. W. Baggs	Technical Writer
J. H. Bugg	Technical Writer
Beverly H. Connor	Technical Writer
Charles C. Connor, Jr	Technical Writer
Beverly J. Fitzpatrick	Technical Writer
B. E. Mills	Technical Writer
James F. Watkins	Technical Writer
Beverley J. Fitzpatrick	Team Leader, Project II

CONTRIBUTORS

C. Paul Scott	Writer, Special Needs
Raymond H. Butler	Writer, Special Needs
Rhonda Hefner Packer	Editor/Writer

GRAPHICS

Deborah Moates	Graphic Technician

TYPISTS

Teresa Whitehead	Project Secretary
Gerry DeWald	Typist
Sylvia Dorsey	Typist
Janie Duceatt	Typist
Marsha Elder	Typist
Carolyn Graham	Typist

Helen Plymale	Typist
Gay Weaver	Typist
Frankie Wright	Typist
Wanda Wright	Typist

Division of Vocational Education
College of Education
University of Georgia, Athens, Ga.

POLICIES AND PROCEDURES FOR THE CENTER

PURPOSE OF THE CENTER

The Vocational Education Materials Center functions within the Division of Vocational Education, University of Georgia. This Center operates under grants from the U.S. Office of Education, and the Georgia State Department of Education with the support of the College of Education. The Center is comprehensive in its commitment and approach to the development and dissemination of materials in the broad field of Vocational Education.

The purpose of the Center is to increase the capability of Georgia's delivery system for Vocational Education. Specifically, the Center is committed to:

1. Develop materials to assist in the implementation of proposed curricula and to enhance the teaching of Vocational Education.
2. Conduct and report curriculum research related to Vocational Education.
3. Provide a production and dissemination center for Vocational Education materials.
4. Provide direct experiences in curriculum development and diffusion for advanced graduate students.
5. Enable faculty members to participate in the development and implementation of a variety of curriculum materials.

Dr. G. L. O'Kelley, Jr.; Chairman
Division of Vocational Education
628 Aderhold Hall
University of Georgia
Athens, Georgia 30602

TABLE OF CONTENTS

SECTION I: PHILOSOPHY AND GOALS (Pink)....................I-1
State....................I-3
Local....................I-5
SECTION II: PURPOSE AND OBJECTIVE (Blue)....................II-1
Purpose of Guide....................II-3
Program Objective....................II-5
SECTION III: D.O.T. DESCRIPTION, EXIT POINTS, TASK (Green)....................III-1
Description of Occupational Field....................III-3
Employability Skills....................III-12
Student Exit Points....................III-14
Task Listing/D.O.T. Code Cross Reference....................III-16
SECTION IV: CURRICULUM STRUCTURE AND COURSE OUTLINE (Yellow)....................IV-1
Curriculum Structure....................IV-3
Course Outline....................IV-6
SECTION V: UNIT GUIDES (Gold)....................V-1
SECTION VI: REFERENCES, RESOURCES (Pink)....................VI-1
Instructional Resource Matrix....................VI-4
Additional Instructional Resources....................VI-54
Publishers and Manufacturers....................VI-59
SECTION VII: STUDENT RECORDS (Blue)....................VII-1
Individual Progress Reports....................VII-4
Group Progress Reports....................VII-5
Instructions for Competency Checklist and Certificate of Competency....................VII-6
Competency Checklist....................VII-7
Certificate of Competency....................VII-9

SECTION VIII: SPECIAL NEEDS STUDENTS (Green)...............VIII-1

Working with the Special Needs Student....................VIII-3

SECTION IX: FACILITY LAYOUT (Yellow)..........................IX-1

Learning Resource Center....................................IX-4

Laboratory..IX-7

SECTION X: DEFINITION OF TERMS (Gold).........................X-1

-Foreword-

It has been the privilege of the Division of Vocational Education, University of Georgia, to participate in the development of 48 curriculum guides for Georgia vocational education programs. This work was sponsored by the Division of Program Development, Office of Vocational Education, State Department of Education. The completion of these guides meets a long standing need to provide a comprehensive curriculum overview of the vocational education programs available in Georgia schools. This developmental activity involved one of the largest professional staffs ever assembled for such work. Numerous teachers, teacher educators and state staff members have either written parts of the guides or served on the field review teams. These professionals were supported by a myriad of technical people and a host of typists who literally worked from dawn to dusk to ensure that the guides were produced in a timely fashion.

Be assured that this guide is not intended to be your curriculum or the curriculum of any school. The purpose of this project staff, and I am sure of the state OVE staff, is to offer a guide with supporting resources and teaching ideas from which the vocational instructor can extract a curriculum that meets local needs. The guide, however, does simplify curriculum decisions concerning sequencing and the selection of resources and media support.

The Task Linkage Project and appropriate V'TECS catalogs were used as the beginning point for this guide and all of the others. To assure that these task listings were directly related to Georgia vocational education programs and industry, they were subjected to additional study and review by appropriate teachers.

At some point in the future, this guide will need to be revised. To ensure that such a revision truly reflects the needs of Georgia's vocational education programs, the developers need your reactions, comments and ideas. We will also be interested in how you use the guide. Let us hear from you.

Paul Scott
Curriculum Guide Projects I & II

SECTION I

PHILOSOPHY & GOALS

VOCATIONAL EDUCATION IN GEORGIA

A. PHILOSOPHY

The Georgia Board of Education perceives vocational education as a vital component in the education of the young and adult citizens of this State. Appropriate programs of vocational education and ancillary services should be made readily available to individuals in middle schools, high schools, postsecondary area vocational-technical schools, vocational divisions of junior colleges, vocational centers, the Quick Start program and other adult programs designed to train or retrain workers for useful and satisfying employment.

Special services and assistance must be provided to those who need it in order to participate or benefit from vocational education. This includes women, minorities, the displaced homemaker and other displaced workers, those with limited English-speaking ability, the disadvantaged and the handicapped.

Since men and women spend the greater part of their lives at some form of work, the State should provide opportunities for all its citizens to develop the knowledge, skills and attitudes necessary for them to secure personally satisfying and socially useful employment.

B. PURPOSE

The purpose of vocational education shall be to improve the economic well-being of Georgia citizens by preparing individuals, through organized learning experiences, to select, obtain and advance in recognized occupations.

POSTSECONDARY VOCATIONAL EDUCATION

A. PURPOSE

The purpose of postsecondary vocational-technical education in Georgia is to improve the economic well-being of adult citizens by providing access to high quality vocational-technical training for skilled and semi-skilled occupations, for improvement of existing skills or for retraining in a new occupation.

B. OBJECTIVES

1. To provide vocational-technical education programs and ancillary services commensurate with the needs and interests of students and available job opportunities.

2. To provide vocational-technical education programs which are current with the state-of-the-art, competency-based, and offer multiple exit points to accomodate the students' occupational objectives.

3. To provide vocational-technical education programs which are articulated with available high school counterparts, to facilitate an easy transition from secondary to postsecondary levels without loss of credit.

4. To provide vocational-technical education programs such that 75% of those individuals who leave or complete a program of occupational preparation will find employment in the field, or a related field, for which trained.

5. To provide those guidance, counseling, financial aid, evaluative, job placement, remedial and other supportive programs and services needed by students to enroll, complete a program and become, or remain, employable in a skilled or semi-skilled occupation.

6. To provide needed assistance to special populations to include women, minorities, limited English-speaking, the displaced homemaker and other displaced workers, the disadvantaged and the handicapped.

7. To provide vocational-technical education programs for full-time and part-time students on campus during the day as well as the evening hours, and to provide appropriate programs for full-time and part-time students off campus in businesses and industries, comprehensive high schools and other locations within the respective schools' service areas.

8. To serve as a center for the delivery of postsecondary and adult vocational-technical education programs and services for the community and assigned service area.

STATEMENT OF LOCAL SYSTEM PHILOSOPHY, PURPOSE AND GOALS FOR VOCATIONAL EDUCATION

(This page is intentionally left blank so that local systems may insert their copy of philosophy, purpose and goals for vocational education.)

SECTION II

PURPOSE & OBJECTIVES

PURPOSE OF GUIDE

The purpose is defined in terms of the functional needs of each of the identified classes of users in the secondary and post secondary systems.

(a) Vocational teachers.

1. Provide a guide for organizing their program of instruction,
2. Assist in establishing program objectives,
3. Serve as a curriculum materials resource guide,
4. Improve communications with employers and advisory committees,
5. Facilitate competency based instruction,
6. Facilitate either group or self-paced instruction,
7. Include content by quarter and semester,
8. Cross-reference with existing state developed instructional materials (PLACE packages and post secondary I.I.).

(b) Vocational supervisors and administrators.

1. Assist in defining the scope and content of their programs,
2. Provide a means to improve curriculum management functions,
3. Serve as a guide for admissions and job placement functions,
4. Improve communications with employers and advisory committees.

(c) Counseling and guidance staff.

1. Provide a data base for counseling and guidance personnel,
2. Identify student exit points (Career Options),
3. Serve as guide for admissions and job placement,
4. Correlate with the new State Board of Education graduation requirements,
5. Provide specific content sequencing by quarter and semester for student scheduling,
6. Provide (a) curriculum options for the disadvantaged handicapped student, (b) curriculum modifications for SPECIAL NEEDS students, (c) typical admission requirements for regular and SPECIAL NEEDS students.

(d) Local Curriculum Coordination Committees.

1. Serve as a guide in working out articulation arrangements,
2. Improve definitions of the relationship between secondary clusters and post secondary specialized programs.

This guide will serve as an ideal communication device between school personnel and the craft advisory committee. By personally reviewing the guide with the local craft advisory committee the teacher will be able to maintain the accuracy of the guide in terms of the local job market and will also be able to inform representatives of local industry regarding the content of the program itself.

MECHANICAL TECHNOLOGY PROGRAM OBJECTIVE

Given appropriate instruction, as suggested by this guide, a student completing the program should demonstrate entry level skills in Mechanical Technology in the areas of knowledge, theoretical structure, tool usage, diagnostic ability, related supportive skills and occupational survival skills.

As the student progresses through the program, sufficient competencies will be acquired to enable the student to enter the occupational field at the following curriculum exit points.

Sheet Metal Worker	(D.O.T. Code 804.281-010)
Sheet Metal Worker, Maintenance	(D.O.T. Code 804.281-010)
Wirer	(D.O.T. Code 729.281-042)
Assembly Technician	(D.O.T. Code 633.261-010)
Electrical Repairer	(D.O.T. Code 829.281-014)
Electronics Mechanic	(D.O.T. Code 828.281-010)
Electronics Assembler	(D.O.T. Code 726.684-018)
Electronics Utility Worker	(D.O.T. Code 726.361-101)

SECTION III

D. O. T. DESCRIPTION, EXIT POINTS, TASKS

DESCRIPTION OF OCCUPATIONAL FIELD

The primary purpose of this section is to provide a general orientation to the occupational field. This orientation may be used by counseling and guidance staff in helping students to select subject areas. It may also be used by instructors for new students just entering the program area. The description delimits the scope of the occupational field in terms of the range of activities involved in a series of occupations. It contains information about career potential within the occupational field, including job market conditions and trends.

The description identifies prerequisite skills and knowledge for those students interested in entering the occupational field. In addition, the Description of Occupational Exit Points is provided to aid the instructor in identifying possible jobs for early leavers. A listing of employability skills is also included in this section.

*MECHANICAL TECHNOLOGY

Nature of the Work

Mechanical technology is a broad term that covers a large number of specialized fields including automotive, diesel, and production technology and tool and machine design.

Technicians assist engineers in design and development work by making freehand sketches and rough layouts of proposed machinery and other equipment and parts. This work requires knowledge of mechanical principles involving tolerance, stress, strain, friction, and vibration factors. They also analyze the costs and practical value of designs.

In planning testing experimental machines and equipment for performance, durability, and efficiency, technicians record data, make computations, plot graphs, analyze results, and write reports. They sometimes recommend design changes to improve performance. Their job often requires skill in the use of complex instruments, test equipment, and gauges, as well as in the preparation and interpretation of drawings.

When a product is ready for production, mechanical technicians help prepare layouts and drawings of the assembly process and of parts to be manufactured. They frequently help estimate labor costs, equipment life, and plant space. Some mechanical technicians test and inspect machines and equipment in manufacturing departments or work with engineers to eliminate production problems. Others are technical sales workers.

Tool designers are among the better known specialists in mechanical engineering technology. Tool designers prepare sketches of designs for cutting tools, jigs, dies, special fixtures, and other devices used in mass production. Frequently, they redesign existing tools to improve their efficiency. They also make, or supervise others who make detailed drawings of tools and fixtures.

Working Conditions

Working conditions in mechanical technology vary. Most employees work regular hours in laboratories and industrial plants. Others work part or all of their time outdoors. Some occasionally are exposed to safety or health hazards from equipment or materials.

Places of Employment

Based on 1978 studies, the major percentage of those employed worked in private industry. In the manufacturing sector, the largest employers were the electrical equipment, chemical, machinery, and aerospace industries. In nonmanufacturing, large numbers worked in wholesale and retail trade, communications, and in engineering and architectural firms.

A large percent of mechanical technology employees were employed by Federal Government agencies such as the Departments of Defense, Transportation, Agriculture, Interior, and Commerce.

A small percentage of employees were employed by State and local governments and by colleges, universities, and non-profit organizations.

Training, Other Qualifications, and Advancement

Although persons can qualify for mechanical technician jobs through many combinations of work experience and education, most employers prefer applicants who have had some specialized technical training.

Persons also can qualify for technician jobs by less formal methods. Workers may learn through on-the-job training, apprenticeship programs, or correspondence schools. Some qualify on the basis of experience gained in the Armed Forces. However, postsecondary training is becoming increasingly necessary for advancement to more responsible jobs.

Those interested in a career in mechanical technology should have an aptitude for mathematics and science and enjoy technical work. An ability to do detailed work with a high degree of accuracy is necessary; for design work, creative talent also is desirable. Technicians are part of a scientific team, and often work closely with engineers and scientists as well as other technicians and skilled workers. Some technicians, such as repair and maintenance technicians, should be able to work independently and to deal effectively with customers.

Employment Outlook

Employment opportunities are expected to be favorable through the 1980's. Opportunities will be best for graduates of postsecondary school technician training programs. Besides openings resulting from the slightly faster than average growth expected in this field, additional technicians will be needed to replace those who die, retire, or leave the occupation.

Industrial expansion and the increasing complexity of modern technology underlie the anticipated increase in demand for technicians. Many will be needed to work with the growing number of engineers and scientists in developing, producing, and distributing new and technically advanced products. Automation of industrial processes and continued growth in new areas of work such as environmental protection and energy development will add to the demand for technical personnel.

The anticipated growth of research and development expenditures in industry and government also should increase requirements for employees in the mechanical technology field.

Sources of Additional Information

For information on careers in mechanical technology contact: Engineers Council for Professional Development, 345 East 47th St., New York, NY 10017. Information on schools offering technician programs is available from: National Association of Trade and Technical Schools, 2021 K St. N.W., Washington, DC 20006. State departments of education also have information about approved technical institutes, within the State offering post-high school training for specific technical occupations. Other sources include: American Association of Community and Junior Colleges, One Dupont Circle, Suite 410, Washington, DC 20036. National Home Study Council, 1601 18th St. N.W., Washington, DC 20002.

---

*Occupational Outlook Handbook, 1980-81 Edition

*Related Occupations

804.281-010 SHEET-METAL WORKER

Fabricates, assembles, installs, and repairs sheet metal products and equipment, such as control boxes, drainpipes, ventilators, and furnace casings, according to job order or blueprints. Selects gage and type of sheet metal according to product being fabricated and knowledge of metal. Locates and marks dimension and reference lines on metal sheet (SHEET-METAL LAYOUT WORKER (any ind.)). Sets up and operates fabricating machines, such as shears, brakes, bending rolls, and punch and drill presses to cut, bend, and straighten sheet metal. Shapes metal over anviles, blocks, or forms, using hammer. Sets up and operates soldering and welding equipment to join together sheet metal parts. Smooths seams, joints, or burred surfaces, using files and portable grinder or buffer. Installs assemblies in plant or worksite according to blueprint specifications, using handtools and portable power tools. Inspects assemblies and installation for conformance with specifications, using measuring instruments, such as calipers, scales, and micrometer. May be designated according to type of metal used as COPPERSMITH (any ind.); PRODUCT-DEVELOPMENT WORKER (any. ind.); TINSMITH (any ind.); or according to type of activity as FABRICATOR, SPECIAL ITEMS (any ind.); MODEL MAKER, SHEET METAL (any ind.); ROOFER, METAL (const.); SHEET-METAL INSTALLER (any ind.); SHEET-METAL WORKER, MAINTENANCE (any ind.); SHOP MECHANIC (any ind.).

804.281-010 SHEET-METAL WORKER, MAINTENANCE

Fabricates, assembles, installs, and repairs sheet metal products and equipment, such as control boxes, drainpipes, ventilators, and furnace casing, according to job order or blueprints. Selects gage and type of sheet metal according to products being fabricated and knowledge of metal. Locates and marks dimension and reference lines on metal sheet (SHEET-METAL LAYOUT WORKER (any ind.)). Sets up and operates fabricating machines, such as shears, brakes, bending rolls, and punch and drill presses to cut, bend, and straighten sheet metal. Shapes metal over anviles, blocks, or forms, using hammer. Sets up and operates soldering and welding equipment to join together sheet metal parts. Smooths seams, joints, or burred surfaces, using files and portable grinder or buffer. Installs assemblies in plant or worksite according to blueprint specifications, using handtools and portable power tools. Installs assemblies and installation for conformance with specifications, using measuring instruments, such as calipers, scales, and micrometer. May be designated according to type of metal used as COPPERSMITH (any ind.); TINSMITH (any ind.); or according to type of activity as FABRICATOR, SPECIAL ITEMS (any ind.); MODEL MAKER, SHEET METAL (any ind.); PRODUCT-DEVELOPMENT WORKER (any ind.); ROOFER, METAL (const.); SHEET-METAL INSTALLER (any ind.); SHEET-METAL WORKER, MAINTENANCE (any ind.); SHOP MECHANIC (any ind.).

729.281-042 WIRER

Installs, adjusts, and repairs wiring and cables in punched card office machines and adding machines according to wiring diagrams, blueprints, and engineering specifications, using handtools, soldering iron, and plugging gun. Reads wiring diagrams, blueprints, wire routing and standards sheets, and engineering specifications to determine lengths, types, routing and colors of wiring and cables to be installed in machines, such as collators, adding machines, reproducing punches, card reader punches, and interpreters. Selects specified wires and cables, routes according to instructions, and fastens connections by bolting, screwing, soldering, or plugging, using wrenches, screwdrivers, soldering iron, and plugging gun (pneumatic gun that forces plug ends of wires into jacks). Inspects previously wired units, such as plugboards, fuse holders, keyboards, and indicator lights, for conformance to specifications, using test devices, such as voltmeters and ohmeters.

633.261-010 ASSEMBLY TECHNICIAN

Inspects, adjusts, and repairs punched-card office machines, such as interpreters, collators, proof machines for banks, and card punches, using handtools and test equipment. Reads machine assembly specifications such as charts, blueprints, schematic diagrams, and engineering specifications to determine requirements, such as drive speed, timing of card feed and output, and installation of special features ordered by customer. Operates machine, using prepunched cards, to observe and listen to operation of moving parts, to measure clearances and contact gaps, and to measure voltages and continuity, using voltmeter, ohmeter, and test lights. Adjusts clearance of moving parts, electrical contact gaps, and alinement of printing units and contact brush units to meet specifications, using tools, such as screwdrivers, wrenches, feeler gages, and special fixtures. Repairs assembly errors noted by quality control personnel. May install hardware, drill holes, and insert pins to complete assembly prior to final testing of machine. May train workers in assembly operations.

829.281-014 ELECTRICAL REPAIRER

Repairs, maintains, and installs electrical systems and equipment, such as motors, transformers, wiring, switches, and alarm systems. Locates and determines electrical malfunction, using test instruments, such as ammeter, oscilloscope, and test lamp. Repairs malfunction by such methods as replacing burnt-out elements and fuses, by-passing or rewiring motors, using handtools. Tests electrical equipment, such as generators and heaters, for safety and efficiency, using standard test equipment. Installs fixtures, motors, and other electrical equipment and makes adjustments using handtools. Inspects circuits and wiring for specified shielding and grounding and repairs or rewires system according to building codes and safety regulations. May replace bearings in electric motors. May repair mechanical, pneumatic, hydraulic, or electronic components of electrical equipment, using standard tools and gages. May plan layout and wire new installations [ELECTRICIAN (any ind.)]. May be required to hold license. May be desginated according to equipment repaired as CIRCUIT-BREAKER MECHANIC (light, heat,& power); ELECTRICIAN, CRANE MAINTENANCE (any ind.); ELECTRICIAN, RECTIFIER MAINTENANCE (light, heat, & power); SALVAGE REPAIRER (light, heat, & power); TIME CLOCK REPAIRER (elec. equip.); TRANSFORMER-COIL WINDER (light, heat, & power); or according to work location as ELECTRICIAN, MACHINE SHOP (mach. shop); ELECTRICIAN, REFINERY (petrol. refin.); UNDERGROUND REPAIRER (light, heat, & power). Additional titles: WATCH ELECTRICIAN (tel. & tel.); WIRER, MAINTENANCE (light, heat, & power).

828.281-010 ELECTRONICS MECHANIC

Repairs electronic equipment, such as computers, industrial controls, radar systems, telemetering and missile control systems, transmitters, antennas, and servomechanisms, following blueprints and manufacturers' specifications, and using handtools and test instruments. Tests faulty equipment and applies knowledge of functional operation of electronic units and systems to diagnose cause of malfunction. Tests electronic components and circuits to locate defects, using oscilloscopes, signal generators, ammeters, and voltmeters. Replaces defective components and wiring and adjusts mechanical parts, using handtools and soldering iron. Alines, adjusts, and calibrates equipment according to specifications. Calibrates testing instruments. Maintains records of repairs, calibrations, and tests. May install equipment in industrial or military establishments and in aircraft and missiles. May operate equipment, such as communication equipment and missile control systems in ground and flight tests, and be required to hold license from governmental agency. May be designated according to type of equipment repaired as CUSTOMER-ENGINEERING SPECIALIST (office mach.); ELECTRONICS MECHANIC, COMPUTER (any ind.); RADAR MECHANIC (any ind.); VOTING-MACHINES REPAIRER (gov. ser.).

726.684-018 ELECTRONICS ASSEMBLER

Assembles electronic components, subassemblies, and systems by any one or combination of following methods. Reads work orders, follows production drawings and sample assemblies, and receives verbal instructions regarding duties to be performed. Positions and alines parts in specified relationship to each other in jig, fixture, or other holding device, using tweezer, vacuum probe, or hand instruments. (1) Tends machines or uses handtools and power tools to crimp, stake, bolt, rivet, weld, solder, cement, press fit, or perform similar operation to secure parts in place. (2) Mounts assembled components such as transformers, resistors, capacitors, integrated circuits, and sockets on chassis, panel, or printed circuit board. (3) Connects component lead wires to printed circuit or routes and connects wires between individual component leads and other components, connectors, terminals, and contact points using soldering, welding, thermocompression, or related bonding procedures. (4) Installs finished assemblies or subassemblies in cases and cabinets. (5) Assembles and attaches functional and cosmetic hardware such as caps, clamps, and knobs to assemblies using handtools and power tools. (6) Performs intermediate assembly tasks such as potting, encapsulating, cleaning, coating, epoxy bonding, curing, stamping, etching, impregnating, and color coding parts and assemblies. (7) Tends machines which press or shape component parts such as contacts, shells, and insulators. (8) Tends automatic assembly equipment which joins components and parts. (9) Winds capacitors on manual or automatic winding equipment. (10) Adjusts or trims material from components such as capacitors and potentiometers to change electronic characteristic to specification measured by electronic test instrument. (11) Performs on-line go-not-go testing and inspection using magnifying devices, fixed and movable measuring instruments and electronic test equipment to insure parts and assemblies meet production specifications and are free from defects. May perform assembly operations under microscope or other magnifying device. Specific titles may be assigned which designate product, subcomponent, equipment used, or processes.

726.361-101 ELECTRONICS UTILITY WORKER

Arranges layout of work station for other workers who fabricate, process, or assemble electronic equipment, and components such as semiconductor devices, printed circuit boards, chassis assemblies, and wire harnesses and cable. Reads specifications, such as process guide, bill or material, wiring diagram, mechanical print, and schematic diagram to determine equipment needed, such as piece parts, chemicals and gases, tools, test instruments, and jigs and fixtures, for work stations. Notifies stockroom when stations need resupply of materials, such as chemicals, resistors, transistors, and color coded wire, during processing or assembly operations. May assist workers to follow new work procedures, and relieve operators from work stations. May set and adjust controls for processing, fabricating, and assembly line equipment, such as furnaces, process chambers, power supplies, timers, and miltimeters. May test and repair assembled items by removing or adding piece parts, or resoldering or rebonding defective connections, using handtools, production equipment, test machines and test instruments, such as meters, resistance bridges, and automatic component testers.

---

*From D.O.T.

EMPLOYABILITY SKILLS

In addition to the aptitudes, abilities, interests, physical requirements and job skills listed in the preceding Description of Occupation, employability skills exert a great deal of influence on a person's ability to get and keep a job. Surveys indicate that more people lose their jobs because of poor attitudes toward their job than for lack of job skills. For this reason it is important that information concerning the following employability skills be provided as an ongoing part of the program.

1. Getting a job
    - a. Filling out job applications
    - b. Developing a resume
    - c. Preparing for a job interview

2. Keeping a job
    - a. Be on time and regular in attendance
    - b. Maintain a fair share of the work-load
    - c. Work without supervision
    - d. Meet production schedules
    - e. Properly care for and use equipment
    - f. Dress appropriately for the job
    - g. Maintain good personal hygiene
    - h. Develop and maintain good communication with supervisors and co-workers

A recent study sponsored by the Illinois Department of Adult, Vocational and Technical Education and conducted by the University of Illinois, "Survival Skills: Mastering the Human Aspects of Work", has identified twelve topics that might be developed into instructional modules for teaching occupational survival skills. The author, Robert E. Nelson, outlines these topics listed below and on the next page, each followed by a general objective which indicates the relationship between the topic and the survival skills required to maintain a job.

*"1. Working in an Organization: To familiarize students with the reasons for the formation of organizations and the common characteristics of organizations.

2. Understanding Self and Others: To have students develop insights into causes of human behavior and learn to interpret their own behavior and the behavior of others.

3. Motivation for Work: To have students develop an understanding of motivation for work and the ability to build positive motivations into the work they perform.

4. Interpersonal Relations: To have students develop concepts and skills in interpersonal relations and apply them to work situations.
5. On-the-Job Communication: To have students understand the importance of effective communication and learn ways of communicating effectively on the job.
6. Using Creativity on the Job: To make students aware of their creative potential and to practice using their creative ability in hypothetical on-the-job situations.
7. Authority and Responsibility: To have students develop an understanding of the concepts of authority, power, influence, and responsibility as they apply to work situations.
8. Problem Solving: To have students develop skill in applying problem solving to their work.
9. Coping with Organizational Change: To make students aware of the process of organizational change and the techniques for coping with organizational change.
10. Coping with Organizational Conflict: To make students aware of the sources and types of conflicts encountered on the job and recognize ways of coping with conflicts in an organization.
11. Leadership: To have students recognize the need for leadership in work groups and increase their understanding of the leadership role in work situations.
12. Adapting and Planning for the Future: To have students develop perspectives of work in the future and the ability to plan for anticipated changes in their work roles."

---

*Abstracted from the article, "Survival Skills: Mastering the Human Aspects of Work," by Robert E. Nelson, American Vocational Journal, November 1977.

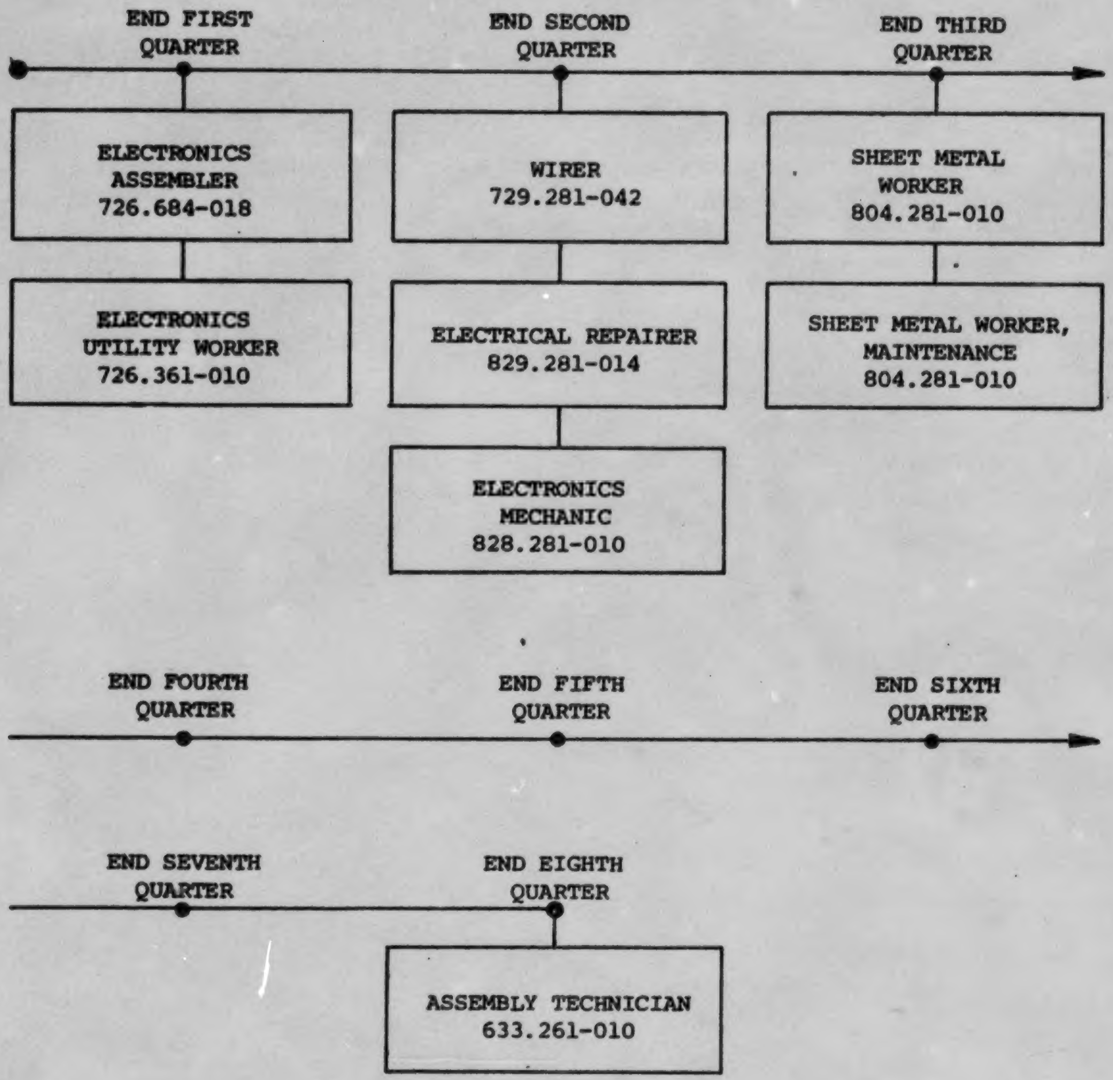
MECHANICAL TECHNOLOGY EXIT POINTS

The diagram on the following page is based on the Suggested Course Outline Structure. It graphically illustrates the points in the Mechanical Technology program where the student should have acquired the competencies necessary for entry level employment into the job classifications indicated. In many cases, by the time a student reaches an exit point, he/she may have acquired several competencies in addition to those required for the specific job classification.

The course outline is structured to prepare students to become Sheet Metal Workers, Maintenance Sheet Metal Workers, Electrical repairers, Wirers, Assembly Technicians, Electronics Mechanics, Electronics Assemblers and Electronics Utility Workers. Every student, upon leaving a vocational program, should have entry level skills in some related occupation.

The Task Listing by DOT Code indicates the entry level skills (tasks) required for the student to be considered employable in a specified occupation. If the local program is individualized, it should be relatively easy to move a potential program leaver (drop out) into those skills (tasks) which would qualify the student for one of the listed occupations.

EXIT POINTS
MECHANICAL TECHNOLOGY


END FIRST QUARTER
END SECOND QUARTER
END THIRD QUARTER
ELECTRONICS ASSEMBLER 726.684-018
WIRER 729.281-042
SHEET METAL WORKER 804.281-010
ELECTRONICS UTILITY WORKER 726.361-010
ELECTRICAL REPAIRER 829.281-014
SHEET METAL WORKER, MAINTENANCE 804.281-010
ELECTRONICS MECHANIC 828.281-010
END FOURTH QUARTER
END FIFTH QUARTER
END SIXTH QUARTER
END SEVENTH QUARTER
END EIGHTH QUARTER
ASSEMBLY TECHNICIAN 633.261-010

TASK LISTING BY D.O.T. CODE

In this section, the occupational exit points from the curriculum are cross referenced with the tasks which are required for employment in each job title. On the line following each task, an X appears in the column of each job title to which the task applies. All the tasks listed in this matrix are taught in the curriculum presented in this guide. A detailed treatment of each task appears in the Unit Guides section of this curriculum guide.

TASK LISTING BY DOT CODE

MECHANICAL TECHNOLOGY

POSSIBLE EXIT POINTS

	DOT DESCRIPTIONS	Sheet Metal Worker	Sheet Metal Worker, Maintenance	Wirer	Assembly Technician	Electrical Repairer	Electronics Mechanic	Electronics Assembler	Electronics Utility Worker
	DOT NO.	804.281-010	804.281-010	729.281-042	633.261-010	829.281-014	828.281-010	726.684-018	726.361-101
TASK NO.	TASK NAME								
	DUTY A: Materials of Industry								
MI-01	Identifying non-metal materials				X				
MI-02	Identifying properties of plastics				X				
MI-03	Identifying properties of rubber				X				
MI-04	Identifying properties and Applications of carbon				X				
MI-05	Identifying industrial chemicals and their applications				X				
MI-06	Identifying paints, coatings and their applications				X				
MI-07	Identifying insulating materials and their applications				X				
MI-08	Identifying properties and applications of construction materials				X				
MI-09	Identifying properties and applications of wood				X				
MI-10	Identifying adhesives and tapes				X				
MI-11	Identifying the physical structure of metals	X			X				
MI-12	Identifying properties of metals	X			X				

TASK LISTING BY DOT CODE

MECHANICAL TECHNOLOGY

POSSIBLE EXIT POINTS

	DOT DESCRIPTIONS	Sheet Metal Worker	Sheet Metal Worker, Maintenance	Wirer	Assembly Technician	Electrical Repairer	Electronics Mechanic	Electronics Assembler	Electronics Utility Worker
	DOT NO.	804.281-010	804.281-010	729.281-042	633.261-010	829.281-014	828.281-010	726.684-018	726.361-101
TASK NO.	TASK NAME								
MI-13	Identifying methods of heat treatment	X			X				
MI-14	Identifying metal manufacturing processes	X			X				
MI-15	Identifying iron manufacturing processes	X			X				
MI-16	Identifying processes used to produce steel	X			X				
MI-17	Identifying processes used to produce aluminum	X			X				
MI-18	Identifying processes for the production of magnesium and titanium	X			X				
MI-19	Identifying processes used to produce copper	X			X				
MI-20	Identifying processes used to produce lead, nickel, tin and zinc	X			X				
	DUTY B: Drafting								
D-01	Lettering by hand				X				
D-02	Freehand sketching				X				

TASK LISTING BY DOT CODE

MECHANICAL TECHNOLOGY

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Sheet Metal Worker 804.281-010	Sheet Metal Worker, Maintenance 804.281-010	Wirer 729.281-042	Assembly Technician 633.261-010	Electrical Repairer 829.281-014	Electronics Mechanic 828.281-010	Electronics Assembler 726.684-018	Electronics Utility Worker 726.361-101
DOT NO.	DOT DESCRIPTIONS								
D-03	Analyzing drawings for acceptable drafting practices				X				
D-04	Drawing plane figures				X				
D-05	Drawing with line contrast				X				
D-06	Drawing to scale				X				
D-07	Drawing in orthographic				X				
D-08	Dimensioning				X				
D-09	Drawing in isometric				X				
D-10	Drawing auxiliary views				X				
D-11	Drawing fundamental views				X				
D-12	Connecting skew lines				X				
D-13	Finding piercing points				X				
D-14	Drawing plane intersections				X				
D-15	Determining dihedral angles				X				
D-16	Determining true length with revolution				X				
D-17	Drawing intersecting solids				X				
D-18	Drawing developments				X				
D-19	Drawing fasteners				X				
D-20	Drawing welds	X			X				
D-21	Dimensioning tolerances	X			X				
D-22	Drawing gears				X				

TASK LISTING BY DOT CODE

MECHANICAL TECHNOLOGY

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	DOT DESCRIPTIONS	Sheet Metal Worker	Sheet Metal Worker, Maintenance	Wirer	Assembly Technician	Electrical Repairer	Electronics Mechanic	Electronics Assembler	Electronics Utility Worker
		DOT NO.	804.281-010	804.281-010	729.281-042	633.261-010	829.281-014	828.281-010	726.684-018	726.361-101
D-23	Drawing cams					X				
D-24	Drawing details		X			X				
D-25	Drawing assemblies		X			X				
D-26	Drawing charts					X				
D-27	Drawing graphs					X				
D-28	Sketching designs					X				
D-29	Drawing sections		X			X				
	DUTY C: Manufacturing Processes									
MP-01	Laying out metal surfaces		X	X		X				
MP-02	Identifying jig buttons					X				
MP-03	Using the sine bar					X				
MP-04	Using the bevel protractor		X			X				
MP-05	Using steel rules		X			X				
MP-06	Using the micrometer		X			X				
MP-07	Reading on vernier scale		X			X				
MP-08	Using dial indicators, center									
	testers and speed indicators					X				
MP-09	Using precision gage blocks,									
	tapered ring, plug and snap gages					X				

TASK LISTING BY DOT CODE

MECHANICAL TECHNOLOGY

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Sheet Metal Worker 804.281-010	Sheet Metal Worker, Maintenance 804.281-010	Wirer 729.281-042	Assembly Technician 633.261-010	Electrical Repairer 829.281-014	Electronics Mechanic 828.281-010	Electronics Assembler 726.684-018	Electronics Utility Worker 726.361-101
	DOT DESCRIPTIONS / DOT NO.								
MP-10	Identifying and using hand hacksaws	X	X		X				
MP-11	Using abrasives and lapping compounds				X				
MP-12	Identifying and using files	X	X		X				
MP-13	Scraping flat and curved bearing surfaces				X				
MP-14	Using hammers and screwdrivers for hand bench use	X	X		X				
MP-15	Identifying and using wrenches	X	X		X				
MP-16	Using bench vices and clamps	X	X		X				
MP-17	Identifying and using chipping tools				X				
MP-18	Using hand taps, dies and hand reamers				X				
MP-19	Identifying power tool safety practices	X	X		X				
MP-20	Assembling and fitting				X				
MP-21	Identifying fasteners	X	X		X				
MP-22	Using thread, center, fillet and radius gages				X				
MP-23	Identifying lubricants and greases				X				
MP-24	Performing machine maintenance				X				
MP-25	Identifying benchwork safety				X				

TASK LISTING BY DOT CODE

MECHANICAL TECHNOLOGY

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Sheet Metal Worker	Sheet Metal Worker, Maintenance	Wirer	Assembly Technician	Electrical Repairer	Electronics Mechanic	Electronics Assembler	Electronics Utility Worker
	DOT NO.	804.281-010	804.281-010	729.281-042	633.261-010	829.281-014	828.281-010	726.684-018	726.361-101
MP-26	Identifying parts and functions of the drilling machine	X	X		X				
MP-27	Identifying safety practices and precautions when using the drilling machine	X	X		X				
MP-28	Identifying work holding devices and set ups	X	X		X				
MP-29	Identifying and using drill bit holding devices	X	X		X				
MP-30	Identifying drill bits	X	X		X				
MP-31	Identifying cutting feeds and speeds	X	X		X				
MP-32	Identifying lathe safety				X				
MP-33	Identifying lathes				X				
MP-34	Identifying work holding devices				X				
MP-35	Identifying cutting tools				X				
MP-36	Identifying measuring tools				X				
MP-37	Identifying lathe attachments				X				
MP-38	Calculating cutting feeds and speeds on the lathe				X				
MP-39	Determining R.P.M.				X				
MP-40	Centering stock				X				
MP-41	Identifying principles of facing				X				

TASK LISTING BY DOT CODE

MECHANICAL TECHNOLOGY

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Sheet Metal Worker	Sheet Metal Worker, Maintenance	Wirer	Assembly Technician	Electrical Repairer	Electronics Mechanic	Electronics Assembler	Electronics Utility Worker
DOT NO.	DOT DESCRIPTIONS	804.281-010	804.281-010	729.281-042	633.261-010	829.281-014	828.281-010	726.684-018	726.361-101
MP-42	Identifying principles of straight turning and turning to shoulders				X				
MP-43	Identifying thread cutting devices				X				
MP-44	Identifying the parts of a thread				X				
MP-45	Identifying American National thread standards				X				
MP-46	Computing American National thread form				X				
MP-47	Computing sharp V-threads formulas				X				
MP-48	Identifying acme threads				X				
MP-49	Identifying square threads				X				
MP-50	Identifying classes of fits of screw threads				X				
MP-51	Using thread gauges				X				
MP-52	Using a thread micrometer				X				
MP-53	Identifying turret lathe				X				
MP-54	Identifying turret lathe safety practices				X				
MP-55	Maintaining the turret lathe				X				
MP-56	Identifying work holding devices				X				
MP-57	Identifying chucking operations on the turret lathe				X				

TASK LISTING BY DOT CODE

MECHANICAL TECHNOLOGY

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Sheet Metal Worker	Sheet Metal Worker, Maintenance	Wirer	Assembly Technician	Electrical Repairer	Electronics Mechanic	Electronics Assembler	Electronics Utility Worker
	DOT NO.	804.281-010	804.281-010	729.281-042	633.261-010	829.281-014	828.281-010	726.684-018	726.361-101
MP-58	Selecting cutting speed and feed on the turret lathe				X				
MP-59	Identifying coolants and cutting compounds				X				
MP-60	Identifying power cut-off saws	X	X		X				
MP-61	Identifying power saw safety	X	X		X				
MP-62	Identifying and using work holding devices on the power cut-off saw	X	X		X				
MP-63	Identifying selecting, mounting and maintaining saw blades	X	X		X				
MP-64	Identifying speeds, feeds and coolants for power cut-off saws	X	X		X				
MP-65	Using the power cut-off saw for straight and angular sawing	X	X		X				
MP-66	Identifying types, sizes, construction, specifications, nomenclature and range of work for shapers				X				
MP-67	Identifying shaper work holding devices and their functions				X				
MP-68	Identifying shaper cutting tools, grinding them and attaching to machine				X				

TASK LISTING BY DOT CODE

MECHANICAL TECHNOLOGY

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Sheet Metal Worker	Sheet Metal Worker, Maintenance	Wirer	Assembly Technician	Electrical Repairer	Electronics Mechanic	Electronics Assembler	Electronics Utility Worker
	DOT NO.	804.281-010	804.281-010	729.281-042	633.261-010	829.281-014	828.281-010	726.684-018	726.361-101
MP-69	Setting up the shaper and calculating speed and feed				X				
MP-70	Adjusting the shaper				X				
MP-71	Performing a horizontal shaping operation				X				
MP-72	Performing a vertical shaping operation				X				
MP-73	Identifying types, sizes, construction, specifications, nomenclature and range of work for planers				X				
MP-74	Identifying and using work holding and clamping devices				X				
MP-75	Identifying planer cutting tools, grinding them and attaching to machine				X				
MP-76	Setting up the planer and calculating speed and feed				X				
MP-77	Performing planing operations				X				
MP-78	Maintaining and caring for the planer				X				
MP-79	Identifying types, sizes, construction, specifications, nomenclature and range of work for milling machines				X				

TASK LISTING BY DOT CODE

MECHANICAL TECHNOLOGY

	POSSIBLE EXIT POINTS							
	DOT DESCRIPTIONS	Sheet Metal Worker	Sheet Metal Worker, Maintenance	Wirer	Assembly Technician	Electrical Repairer	Electronics Mechanic	Electronics Assembler	Electronics Utility Worker
	DOT NO.	804.281-010	804.281-010	729.281-042	633.261-010	829.281-014	828.281-010	726.684-018	726.361-101
TASK NO.	TASK NAME								
MP-80	Identifying milling machine work holding devices and their function				X				
MP-81	Identifying, selecting and aligning milling machine attachments				X				
MP-82	Selecting and setting up milling machine cutters and holders				X				
MP-83	Calculating cutting speeds and feeds for milling machine work				X				
MP-84	Performing a plain milling operation				X				
MP-85	Identifying types of gears and their functions				X				
MP-86	Identifying gear tooth elements and their symbols				X				
MP-87	Calculating the pitch, diameters, working depth and clearances for machining gears				X				
MP-88	Identifying grinders, grinding wheels and attachments				X				
MP-89	Using the bench grinder				X				
MP-90	Identifying materials used in sheet metalwork	X	X		X				

TASK LISTING BY DOT CODE

MECHANICAL TECHNOLOGY

POSSIBLE EXIT POINTS

	DOT DESCRIPTIONS	Sheet Metal Worker	Sheet Metal Worker, Maintenance	Wirer	Assembly Technician	Electrical Repairer	Electronics Mechanic	Electronics Assembler	Electronics Utility Worker
	DOT NO.	804.281-010	804.281-010	729.281-042	633.261-010	829.281-014	828.281-010	726.684-018	726.361-101
TASK NO.	TASK NAME								
MP-91	Developing sheet metal patterns (stretchouts)	X	X		X				
MP-92	Cutting sheet metal	X	X		X				
MP-93	Bending sheet metal by hand	X	X		X				
MP-94	Bending metal on a bar folder or brake	X	X		X				
MP-95	Roll-forming sheet metal	X	X		X				
MP-96	Making seams	X	X		X				
MP-97	Using the rotary machine	X	X		X				
MP-98	Fastening sheet metal	X	X		X				
MP-99	Soft soldering sheet metal	X	X		X				
	DUTY D: Mechanics and Design								
MD-01	Transforming units				X				
MD-02	Calculating resultant force				X				
MD-03	Calculating forces in static systems				X				
MD-04	Calculating stress				X				
MD-05	Calculating strain				X				
MD-06	Calculating deformation				X				
MD-07	Calculating restoring force				X				

TASK LISTING BY DOT CODE

MECHANICAL TECHNOLOGY

POSSIBLE EXIT POINTS

	DOT DESCRIPTIONS	Sheet Metal Worker	Sheet Metal Worker, Maintenance	Wirer	Assembly Technician	Electrical Repairer	Electronics Mechanic	Electronics Assembler	Electronics Utility Worker
	DOT NO.	804.281-010	804.281-010	729.281-042	633.261-010	829.281-014	828.281-010	726.684-018	726.361-101
TASK NO.	TASK NAME								
MD-08	Designing area of materials under stress				X				
MD-09	Calculating frictional forces				X				
MD-10	Calculating mass				X				
MD-11	Describing motion on one dimension				X				
MD-12	Describing motion resulting from forces				X				
MD-13	Describing motion resulting from torques				X				
MD-14	Describing motion using momentum principles				X				
MD-15	Describing motion using energy principles				X				
MD-16	Calculating work				X				
MD-17	Calculating power				X				
MD-18	Calculating efficiency				X				
	DUTY E: Fluid Power								
FP-01	Identifying principles of hydraulics				X				
FP-02	Identifying hydraulic fluids				X				

TASK LISTING BY DOT CODE

MECHANICAL TECHNOLOGY

POSSIBLE EXIT POINTS

	DOT DESCRIPTIONS	Sheet Metal Worker	Sheet Metal Worker, Maintenance	Wirer	Assembly Technician	Electrical Repairer	Electronics Mechanic	Electronics Assembler	Electronics Utility Worker
	DOT NO.	804.281-010	804.281-010	729.281-042	633.261-010	829.281-014	828.281-010	726.684-018	726.361-101
TASK NO.	TASK NAME								
FP-03	Identifying strainers and filters in hydraulic systems				X				
FP-04	Identifying reservoirs and accumulators in hydraulic systems				X				
FP-05	Identifying pumps on hydraulic systems				X				
FP-06	Identifying piping, tubing and fittings				X				
FP-07	Identifying directional control valves				X				
FP-08	Identifying pressure control valves				X				
FP-09	Identifying cylinders				X				
FP-10	Identifying hydraulic motors				X				
FP-11	Identifying pneumatic principles				X				
FP-12	Identifying reciprocating compressors				X				
FP-13	Identifying rotary compressors				X				
FP-14	Identifying primary air treatment in pneumatic systems				X				
FP-15	Identifying secondary air treatment methods				X				
FP-16	Identifying piping, hoses and fittings used in pneumatic systems				X				

TASK LISTING BY DOT CODE

MECHANICAL TECHNOLOGY

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Sheet Metal Worker	Sheet Metal Worker, Maintenance	Wirer	Assembly Technician	Electrical Repairer	Electronics Mechanic	Electronics Assembler	Electronics Utility Worker
	DOT NO.	804.281-010	804.281-010	729.281-042	633.261-010	829.281-014	828.281-010	726.684-018	726.361-101
FP-17	Identifying conrol valves				X				
FP-18	Identifying pressure relief valves				X				
FP-19	Identifying cylinders				X				
FP-20	Identifying motors				X				
	DUTY F: Electricity								
EL-01	Defining terminology and analyzing theory associated with basic D.C. circuits			X	X	X	X	X	X
EL-02	Defining and converting electrical units associated with basic D.C. and A.C. circuits			X	X	X	X	X	X
EL-03	Calculating basic D.C. series circuits			X	X	X	X	X	X
EL-04	Calculating basic D.C. parallel circuits			X	X	X	X	X	X
EL-05	Calculating basic D.C. series parallel circuits			X	X	X	X	X	X
EL-06	Defining terminology and analyzing theory associated with basic A.C. circuits			X	X	X	X	X	X

TASK LISTING BY DOT CODE

MECHANICAL TECHNOLOGY

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	DOT DESCRIPTIONS	Sheet Metal Worker	Sheet Metal Worker, Maintenance	Wirer	Assembly Technician	Electrical Repairer	Electronics Mechanic	Electronics Assembler	Electronics Utility Worker
		DOT NO.	804.281-010	804.281-010	729.281-042	633.261-010	829.281-014	828.281-010	726.684-018	726.361-101
EL-07	Calculating power factors, impedance and pure resistance in series A.C. circuits				X	X	X	X		
EL-08	Calculating basic series A.C. circuits with inductance reactance and resistance					X	X	X		
EL-09	Calculating basic series A.C. circuits with capacitive reactance and resistance					X	X			
EL-10	Calculating series A.C. circuits with capacitive and inductive reactance and resistance					X	X			
EL-11	Calculating basic impedance in parallel A.C. circuits					X	X			
EL-12	Applying basic A.C. circuit theory when drawing residential cable layouts from engineering sketches				X	X	X			
EL-13	Applying basic A.C. circuit theory when drawing commercial cable layouts from engineering sketches				X	X	X			
EL-14	Drawing electrical one-line diagrams from engineering sketches				X	X	X			

TASK LISTING BY DOT CODE

MECHANICAL TECHNOLOGY

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Sheet Metal Worker	Sheet Metal Worker, Maintenance	Wirer	Assembly Technician	Electrical Repairer	Electronics Mechanic	Electronics Assembler	Electronics Utility Worker
	DOT NO.	804.281-010	804.281-010	729.281-042	633.261-010	829.281-014	828.281-010	726.684-018	726.361-101
EL-15	Drawing electrical elementary diagrams from engineering sketches				X	X			
EL-16	Drawing electronic schematic diagrams from engineering sketches			X	X	X			
EL-17	Laying out, taping up and/or drawing basic printed circuit boards				X	X	X	X	
EL-18	Planning and performing site work for a small industrial facility			X	X	X	X		X
EL-19	Making calculations for electric motors, welders and heaters			X	X	X	X		X
EL-20	Selecting the correct transformer bank			X	X	X	X		X
EL-21	Operating a split phase motor			X	X	X	X		X
EL-22	Operating a capacitor start motor			X	X	X	X		X
EL-23	Operating a universal motor			X	X	X	X		X
EL-24	Operating an induction regulator			X	X	X	X		X
EL-25	Operating a rotary frequency changer								X
EL-26	Operating a rotary converter			X	X	X	X		X

SECTION IV

CURRICULUM STRUCTURE & COURSE OUTLINE

CURRICULUM STRUCTURE

The following example of a curriculum structure is provided to illustrate one way a Mechanical Technology curriculum may be structured. The example is not intended to imply that there are not other ways to structure the curriculum.

This curriculum structure is based on the Suggested Course Outline that follows. The actual amount of time required for each course will vary according to local program objectives and depends upon the instructor, the students and facilities available.

Instructors are encouraged to structure their curriculum and make time estimates based on their experiences, industry requirements, student's needs and the local facilities (classroom, equipment, lab) available.

MECHANICAL TECHNOLOGY CURRICULUM STRUCTURE

Course Number	Course	Clock Hours
	First Quarter	
	Non-Metal Materials	115
	Metal Materials	135
	Related Instruction	62
		312
	Second Quarter	
	Drafting I	160
	Drafting II	110
	Related Instruction	42
		312
	Third Quarter	
	Bench Work	195
	Drilling Machine	45
	Related Instruction	72
		312
	Fourth Quarter	
	Engine Lathe Work	201
	Turret Lathe Work	40
	Related Instruction	71
		312
	Fifth Quarter	
	Power Saws	35
	Shaper Work	55
	Planer Work	45
	Milling Machine Work	70
	Grinder Work	75
	Related Instruction	32
		312
	Sixth Quarter	
	Mechanics and Design	215
	Related Instruction	97
		312

Course Number	Course	Clock Hours
	Seventh Quarter	
	Hydraulics	125
	Pneumatics	110
	Related Instruction	77
		312
	Eighth Quarter	
	Electrical Theory	132
	Electrical Drafting	60
	Electricity/Electronics	120
		312

COURSE OUTLINE

The following sample quarter course outline is to be used as an example to facilitate the development of alternative outlines for the individual learner. The listing of major blocks within a quarter is not to indicate a sequenced pattern. All duty areas are independent, therefore, a group of students should begin the quarter by learning different tasks. This allows better coordination of the lab hours and the learning objectives may be selected according to the type of projects or equipment available.

The time estimations for completion of the activities are based on opinions of several Mechanical Technology instructors and published data. The estimates are a minimum amount of time required and should be extended according to the learner's individual needs.

SUGGESTED COURSE OUTLINE STRUCTURE FOR MECHANICAL TECHNOLOGY

Unit/Task	Title	Classroom & Lab Hours
	Quarter I	
	Performance Group: Non-Metal Materials	
MI-01	Identifying non-metal materials	15
MI-02	Identifying properties of plastics	20
MI-03	Identifying properties of rubber	10
MI-04	Identifying properties and applications of carbon	10
MI-05	Identiyfing industrial chemicals and their applications	10
MI-06	Identifying paints, coatings and their applications	10
MI-07	Identifying insulating materials and their applications	10
MI-08	Identifying properties and applications of construction materials	15
MI-09	Identifying properties and applications of wood	15
	Performance Group: Metal Materials	
MI-10	Identifying adhesives and tapes	10
MI-11	Identifying the physical structure of metals	10
MI-12	Identifying properties of metals	10
MI-13	Identifying methods of heat treatment	15
MI-14	Identifying metal manufacturing processes	15
MI-15	Identifying iron manufacturing processes	15
MI-16	Identifying processes used to produce steel	15
MI-17	Identifying processes used to produce aluminum	15
MI-18	Identifying processes for the production of magnesium and titanium	15
MI-19	Identifying processes used to produce copper	15
MI-20	Identifying processes used to produce lead, nickel, tin and zinc	15
	Classroom and Lab Hours	265
	Related Instruction Hours	47
	Quarter One Total Hours	312

Unit/Task	Title	Classroom & Lab Hours
	Quarter II	
	Performance Group: Basic Drafting	
D-01	Lettering by hand	5
D-02	Freehand sketching	10
D-03	Analyzing drawings for acceptable drafting practice	5
D-04	Drawing plane figures	10
D-05	Drawing with line contrast	10
D-06	Drawing to scale	15
D-07	Drawing in orthographic	10
D-08	Dimensioning	5
D-09	Drawing in isometric	10
D-10	Drawing auxiliary views	10
D-11	Drawing fundamental views	10
D-12	Connecting skew lines	5
D-13	Finding piercing points	5
D-14	Drawing plane intersections	10
D-15	Determining dihedral angle	10
D-16	Determining true length with revolution	10
D-17	Drawing intersecting solids	10
D-18	Drawing developments	10
	Performance Group: Machine Drawings	
D-19	Drawing fasteners	10
D-20	Drawing welds	10
D-21	Dimensioning tolerances	5
D-22	Drawing gears	15
D-23	Drawing cams	15
D-24	Drawing details	10
D-25	Drawing assemblies	10
D-26	Drawing charts	10
D-27	Drawing graphs	10
D-28	Sketching designs	10
D-29	Drawing sections	10
	Classroom and Lab Hours	275
	Related Instruction Hours	37
	Quarter Two Total Hours	312

Unit/Task	Title	Classroom & Lab Hours
	Quarter III	
	Performance Group: Bench Work	
MP-01	Laying out metal surfaces	5
MP-02	Identifying jig buttons	5
MP-03	Using the sine bar	10
MP-04	Using the bevel protractor	5
MP-05	Using steel rules	5
MP-06	Using the micrometer	15
MP-07	Reading a vernier scale	10
MP-08	Using dial indicators, center testers and speed indicators	10
MP-09	Using precision gage blocks, tapered ring, plug and snap gages	10
MP-10	Identifying and using hand hacksaws	5
MP-11	Using abrasives and lapping compounds	10
MP-12	Identifying and using files	5
MP-13	Scraping flat and curved bearing surfaces	10
MP-14	Using hammers and screwdrivers for hand bench use	10
MP-15	Identifying and using wrenches	5
MP-16	Using bench vises and clamps	5
MP-17	Identifying and using chipping tools	10
MP-18	Using hand taps, dies and hand reamers	10
MP-19	Identifying power tool safety practices	5
MP-20	Assembling and fitting	10
MP-21	Identifying fasteners	10
MP-22	Using thread, center, fillet and radius gages	10
MP-23	Identifying lubricants and greases	5
MP-24	Performing machine maintenance	5
MP-25	Identifying bench work safety	5
	Performance Group: Drilling Machine	
MP-26	Identifying parts and functions of the drilling machine	5
MP-27	Identifying safety practices and precautions when using the drilling machine	5
MP-28	Identifying work holding devices and setups	10
MP-29	Identifying and using drill bit holding devices	10
MP-30	Identifying drill bits	5
MP-31	Identifying cutting feeds and speeds	5

Unit/Task	Title	Classroom & Lab Hours
	Quarter III	
	Classroom and Lab Hours	235
	Related Instruction Hours	77
	Quarter Three Total Hours	312

Quarter IV

Unit/Task	Title	Classroom & Lab Hours
	Performance Group: Engine Lathe Work	
MP-32	Identifying lathe safety	5
MP-33	Identifying lathes	5
MP-34	Identifying work holding devices	10
MP-35	Identifying cutting tools	10
MP-36	Identifying measuring tools	12
MP-37	Identifying lathe attachments	10
MP-38	Calculating cutting feeds and speeds	22
MP-39	Determining RPM	12
MP-40	Centering stock	10
MP-41	Identifying principles of facing	10
MP-42	Identifying principles of straight turning to shoulders	15
MP-43	Identifying thread cutting devices	15
MP-44	Identiyfing the parts of a thread	10
MP-45	Identifying American National Thread standards	10
MP-46	Computing American National Thread form	10
MP-47	Computing sharp V-thread formulas	10
MP-48	Identifying acme threads	10
MP-49	Identifying square threads	5
MP-50	Identifying classes of fits of screw threads	10
MP-51	Using thread gauges	5
MP-52	Using a thread micrometer	10
	Performance Group: Turret Lathe Work	
MP-53	Identifying turret lathe	5
MP-54	Identifying turret lathe safety practices	5
MP-55	Maintaining the turret lathe	5
MP-56	Identifying work holding devices	5
MP-57	Identifying chucking operations on the turret lathe	10
MP-58	Selecting cutting speed and feed on the turret lathe	5
MP-59	Identifying coolants and cutting compounds	5
	Classroom and Lab Hours	256
	Related Instruction Hours	56
	Quarter Four Total Hours	312

Unit/Task	Title	Classroom & Lab Hours
	Quarter V	
	Performance Group: Power Saw Work	
MP-60	Identifying power cut-off saws	5
MP-61	Identifying power saw safety	5
MP-62	Identifying and using work-holding devices on the power cut-off saw	5
MP-63	Identifying, selecting, mounting and maintaining saw blades	5
MP-64	Identifying speeds, feeds and coolants for power cut-off saws	10
MP-65	Using the power cut-off saw for straight and angular sawing	5
MP-66	Identifying types, sizes, construction, specifications, nomenclature and range of work for shapers	10
MP-67	Identifying shaper work holding devices and their functions	5
MP-68	Identifying shaper cutting tools, grinding them and attaching to machine	5
MP-69	Setting up the shaper and calculating speed and feed	10
MP-70	Adjusting the shaper	5
MP-71	Performing a horizontal shaping operation	10
MP-72	Performing a vertical shaping operation	10
	Performance Group: Planer Work	
MP-73	Identifying types, sizes, construction, specifications, nomenculature and range of work for planers	10
MP-74	Identifying and using work holding and clamping devices	5
MP-75	Identifying planer cutting tools, grinding them and attaching to machine	10
MP-76	Setting up the planer and calculating speed and feed	5
MP-77	Perform planing operations	10
MP-78	Maintaining and caring for the planer	5
	Performance Group: Milling Machine Work	
MP-79	Identifying types, sizes, construction, specifications, nomenclature and range of work for milling machines	10
MP-80	Identifying milling machine work holding devices and their functions	5

Unit/Task	Title	Classroom & Lab Hours
MP-81	Identifying, selecting and aligning milling machine attachments	5
MP-82	Selecting and setting up milling machine cutters and holders	5
MP-83	Calculating cutting speeds and feeds for milling machine work	10
MP-84	Performing a plain milling operation	10
MP-85	Identifying types of gears and their operations	10
MP-86	Identifying gear tooth elements and their symbols	5
MP-87	Calculating the pitch, diameters, working depth and clearances for milling gears	10

Performance Group: Grinder Work

Unit/Task	Title	Classroom & Lab Hours
MP-88	Identifying grinders, grinding wheels and attachments	5
MP-89	Using the bench grinder	5

Performance Group: Sheet Metal Work

Unit/Task	Title	Classroom & Lab Hours
MP-90	Identifying materials used in sheet metal work	10
MP-91	Developing sheet metal patterns (stretch-outs)	10
MP-92	Cutting sheet metal	5
MP-93	Bending sheet metal by hand	5
MP-94	Bending metal on a bar folder or brake	10
MP-95	Roll-forming sheet metal	10
MP-96	Making seams	5
MP-97	Using the rotary machine	5
MP-98	Fastening sheet metal	5
MP-99	Soft soldering sheet metal	5

Classroom and Lab Hours	285
Related Instruction Hours	27
Quarter Five Total Hours	312

Quarter VI

Performance Group: Mechanics and Design

Unit/Task	Title	Classroom & Lab Hours
MD-01	Transforming units	15
MD-02	Calculating resultant force	15
MD-03	Calculating forces in static systems	10
MD-04	Calculating stress	15
MD-05	Calculating strain	10
MD-06	Calculating deformation	10
MD-07	Calculating restoring force	10
MD-08	Designing area of materials under stress	15
MD-09	Calculating frictional forces	10
MD-10	Calculating mass	10
MD-11	Describing motion in one dimension	10
MD-12	Describing motion resulting from forces	10
MD-13	Describing motion resulting from torques	10
MD-14	Describing motion using momentum principles	10
MD-15	Describing motion using energy principles	10
MD-16	Calculating work	15
MD-17	Calculating power	15
MD-18	Calculating efficiency	15
	Classroom and Lab Hours	215
	Related Instruction Hours	97
	Quarter Six Total Hours	312

Unit/Task	Title	Classroom & Lab Hours
	Quarter VII	
	Performance Group: Hydraulics	
FP-01	Identifying principles of hydraulics	10
FP-02	Identifying hydraulic fluids	10
FP-03	Identifying strainers and filters in hydraulic systems	10
FP-04	Identifying reservoirs and accumulators in hydraulic systems	10
FP-05	Identifying pumps on hydraulic systems	15
FP-06	Identifying piping tubing and fittings	15
FP-07	Identifying directional control valves	15
FP-08	Identifying pressure control valves	15
FP-09	Identifying cylinders	10
FP-10	Identifying hydraulic motors	15
	Performance Group: Pneumatics	
FP-11	Identifying pneumatic principles	10
FP-12	Identifying reciprocating compressors	15
FP-13	Identifying rotary compressors	15
FP-14	Identifying primary air treatment in pneumatic systems	10
FP-15	Identifying secondary air treatment methods	5
FP-16	Identifying piping, hoses and fittings used in pneumatic systems	10
FP-17	Identifying control valves	10
FP-18	Identifying pressure relief valves	10
FP-19	Identifying cylinders	5
FP-20	Identifying motors	20
	Classroom and Lab Hours	235
	Related Instruction Hours	77
	Quarter Seven Total Hours	312

Unit/Task	Title	Classroom & Lab Hours
	Quarter VIII	
	Performance Group: Electrical Theory	
EL-01	Defining terminology and analyzing theory associated with basic D.C. circuits	12
EL-02	Defining and converting electrical units associated with basic D.C. and A.C. circuits	12
EL-03	Calculating basic D.C. series circuits	12
EL-04	Calculating basic D.C. parallel circuits	12
EL-05	Calculating basic D.C. series parallel circuits	12
EL-06	Defining terminology and analyzing theory associated with basic A.C. circuits	12
EL-07	Calculating power factors, impedance and pure resistance in series A.C. circuits	12
EL-08	Calculating basic series A.C. circuits with inductance reactance and resistance	12
EL-09	Calculating basic series A.C. circuits with capacitive reactance and resistance	12
EL-10	Calculating series A.C. circuits with capacitive reactance and resistance	12
EL-11	Calculating basic impedance in parallel A.C. circuits	12
	Performance Group: Electrical Drafting	
EL-12	Applying basic A.C. circuit theory when drawing residential cable layouts from engineering sketches	12
EL-13	Applying basic A.C. circuit theory when drawing commerical cable layouts from engineering sketches	12
EL-14	Drawing electrical one-line diagrams from engineering sketches	12
EL-15	Drawing electrical elementary diagrams from engineering sketches	12
EL-16	Drawing electronic schematic diagrams from engineering sketches	12
	Performance Group: Electricity and Electronics	
EL-17	Laying out, taping up, and/or drawing basic printed circuit boards	12
EL-18	Planning and performing site work for a small industrial facility	12

Unit/Task	Title	Classroom & Lab Hours
EL-19	Making calculations for electric motors, welders and heaters	12
EL-20	Selecting the correct transformer band	12
EL-21	Operating a split phase motor	12
EL-22	Operating a capacitor start motor	12
EL-23	Operating a universal motor	12
EL-24	Operating an induction regulator	12
EL-25	Operating a rotary frequency changer	12
EL-26	Operating a rotary converter	12
	Classroom and Lab Hours	312
	Related Instruction Hours	0
	Quarter Eight Total Hours	312

SECTION V

UNIT GUIDES

UNIT GUIDES

Description

In this section the tasks to be taught in each course are presented in sequential order. Each task is listed on a separate page so that it may be taken out of the guide for daily lesson planning or regrouped with other tasks to fit the individual teacher's own preference for teaching order. The task pages may be used for planning and executing group instruction or for individualized instruction. Each page in the UNIT GUIDES section contains the following information:

TASK: This is a short and concise statement of the task to be taught.

PERFORMANCE OBJECTIVE: The performance expected of the student after completing the unit is stated in stem form, without a specific statement of all conditions, equipment and performance standard (these are listed in a criterion referenced measure in the Evaluation section of the task page).

INSTRUCTIONAL ACTIVITIES: Suggested learning activites are presented. These activities include providing information, demonstrating use of audio visuals and practical applications.

INSTRUCTIONAL MATERIALS: The materials that are necessary to carry out the instructional activities are listed. These include textbooks, audio visuals and equipment.

EVALUATION: This section contains a criterion referenced measure (where appropriate) and reference to any test items or other evaluation measures that are available to the teacher. The criterion referenced measure contains three parts--Condition, Performance and Standard.

CLASSROOM HOURS: This figure represents the total hours estimated for all instructional activities and evaluation necessary to teach the task, including shop or laboratory time for student practical application activities.

TASK

MI-01 Identifying non-metal materials

PERFORMANCE OBJECTIVE

Identify non-metal materials.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Classifying materials
    1. Solid
    2. Liquid
    3. Gas
    4. Kinetic energy
b. Properties of gases
    1. Standard temperature and pressure
    2. Intensity
c. Behavior of gases
    1. $P_1 V_1 = P_2 V_2$ (Boyle's Law)
    2. Changing a gas to a liquid
d. Properties of liquids
    1. Meniscus
    2. Viscosity
    3. Density
    4. Specific gravity
    5. Freezing point
    6. Vapor pressure
    7. Evaporation
    8. Condensation
    9. Boiling point
    10. Volatility
    11. Buoancy
e. Behavior of liquids at rest
f. Fluids in motion
    1. Streamline or laminar flow
    2. Turbulent flow
    3. Cavitiation
g. Solids
    1. Crystalline structures
    2. Melting point
    3. Amorphous materials
h. Mixed phases

INSTRUCTIONAL MATERIALS

Textbooks:

Olivio and Olivio, Fundamentals of Applied Physics

Student Manuals:

Plant Engineering Training Systems, Non-metal Materials, Lesson One

CLASSROOM HOURS

15

EVALUATION (MI-01)

Given specifications for a non-metal substance, the student will identify the substance in terms of its state of matter and describe its properties according to the instructor's specifications.

TASK

MI-02 Identifying properties of plastics

PERFORMANCE OBJECTIVE

Identify properties of plastics.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Nature of plastics
    1. Polymers
    2. Polymerization
    3. Resins
    4. Thermoplastics
    5. Thermosets
    6. Tradenames
b. Processing and fabricating plastics
c. Molding processes
    1. Injection molding
    2. Compression molding
    3. Transfer molding
    4. Blow molding
    5. Thermoforming
    6. Rotational molding
d. Casting and foaming processes
    1. Expanded bead molding
    2. Foam molding
e. Extrusion
    1. Blown film extrusion
    2. Wire extrusion coating
f. Reinforced plastics
    1. Calendering
    2. Laminations
    3. Filament winding
g. Machining plastics
    1. Sawing
    2. Drilling
    3. Cutting threads
    4. Grinding, sanding, buffing
    5. Metal inserts

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Schmidt, Basic Plastics
b. Richardson, Modern Industrial Plastics

A/Vs:

Bobbs-Merrill, Slide/tape
#97651, "Foam Molding";
#97652, "Injection Molding";
#97653, "Polymer Structure";
#97654, "Reinforced Plastics";
#97655, "Rotational Molding";
#97654, "Thermofolding"

Student Manuals:

Plant Engineering Training Systems, Non-metal Materials, Lesson Two

CLASSROOM HOURS 20

EVALUATION (MI-02)

Given specifications for a plastic material, the student will identify the type of plastic, the process used to produce it and its applications. The completed task must comply with the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

h. Plastic assembly methods
    1. Processes
    2. Safety
i. Plastic welding
j. Patching with plastic
    1. Polyesters
    2. Epoxus

TASK

MI-03 Identifying properties of rubber

PERFORMANCE OBJECTIVE

Identify properties of rubber.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Nature of rubber
   1. Latex
   2. Elasticity
   3. Resilience
   4. Elastomers
   5. Permanent set
   6. Impermeable
b. Rubber processing
c. Kinds of rubber
   1. Natural rubber
   2. SBR
   3. Butly rubber
   4. Neoprene
   5. Polysulfide rubber
   6. Nitrile rubber
   7. Silicone rubber
   8. Fluorocarbon rubber
d. Groups of rubber
   1. Class R
   2. Class S
   3. Class T
e. Properties of rubber
   1. Electrical resistance
   2. Flame resistance
   3. Impermeability
   4. Resistance to heat or cold
   5. Oxidation
f. Rubber applications
g. Vulcanizing rubber
h. Foamed rubber
   1. Inert gas under pressure
   2. Blowing agent
   3. Whipped latex

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Smith, Materials of Construction

Student Manuals:

Plant Engineering Training Systems, Non-metal Materials, Lesson Three

CLASSROOM HOURS

10

EVALUATION (MI-03)

Given specifications for a rubber application, the student will correctly identify the type of rubber, its properties and the process used to produce it.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

i. Hoses and tubing
    1. Lining
    2. Reinforcement
    3. Cover
j. Tank linings
k. Conveyor and drive belts
l. Sheet rubber
m. Wire and cable insulation
n. Reclaiming rubber

TASK

MI-04 Identifying properties and applications of carbon

PERFORMANCE OBJECTIVE

Identify properties and applications of carbon.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Carbon and graphite
    1. Forms of carbon
    2. Applications of carbon
    3. Forms of graphite
    4. Applications of graphite
    5. Production of graphite
    6. Charcoal
    7. Lamp black
b. Properties and characteristics of carbon and graphite
    1. Heat resistance
    2. Thermal shock resistance
    3. Heat and electrical conductivity
    4. Does not melt
    5. Inert to chemical action
    6. Lubricates under special conditions
c. Carbon in batteries and resistors
    1. Carbon rods in batteries
    e. Carbon piles for current control
    3. Construction of a resistor
d. Carbon electrodes for lighting and welding
e. Refractory (furnace) applications of carbon

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Smith, Materials of Construction

Student Manuals:

Plant Engineering Training Systems, Non-metal Materials, Lesson Four

CLASSROOM HOURS 10

EVALUATION (MI-04)

Given specifications for a carbon or graphite material, the student will correctly identify their applications and describe the process used to produce them.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

f. Carbon brushes
g. Carbon brush problems
    1. Noisy operation
    2. Burned spots
    3. Excessive surface film build-up
    4. Oil on the commutator
h. Carbon brush grades
i. Industrial diamonds
j. Fabricating carbon and graphite products
    1. Powder base
    2. Binder material such as pitch, tar, resins
    3. Heat
k. Mechanical parts and seals
l. Carbon bearings
m. Pump and valve parts
n. Chemical application

TASK

MI-05 Identifying industrial chemicals and their applications

PERFORMANCE OBJECTIVE

Identify industrial chemicals and their applications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Characteristics of chemicals
    1. Acid
    2. Neutral
    3. Alkaline
    4. pH scale
    5. Safety
b. Soaps and detergents
    1. Tallow
    2. Detergents - surfactants
    3. Biodegradable detergents
c. Alkali cleansers
d. Solvents
    1. Chlorinated solvents
    2. Thinners
e. Acids
    1. Safety
    2. Muriatic
    3. Nitric
    4. Phosphoric
    5. Sulfamic
f. Industrial gases
    1. Nitrogen
    2. Oxygen
    3. Chlorine
    4. Carbon dioxide
    5. Ammonia
    6. Hydrogen
    7. Acetylene
g. Packaged chemicals
    1. Types
    2. Applications
h. Aerosols

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Smith, Materials of Construction

Student Manuals:

Plant Engineering Training Systems, Non-metal Materials, Lesson Five

CLASSROOM HOURS

10

EVALUATION (MI-05)

Given a specified industrial chemical, the student will identify the chemical and describe its applications according to the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

i. Lubricants and oils
    1. Graphite
    2. Molybdenum
j. Refrigerants and water treatments
    1. Ammonia
    2. Chlorinated and hydrocarbons florinated
    3. Safety
k. Welding and plating aids
l. Fuels
m. Fire fighting chemicals
    1. Class A
    2. Class B
    3. Class C
    4. Class D
n. Protective equipment
    1. Clothing
    2. Safety instruments

TASK

MI-06 Identifying paints, coatings and their applications

PERFORMANCE OBJECTIVE

Identify paints, coatings and their applications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Applications
   1. Wood protection
   2. Steel protection
b. Substrates
   1. Fabric
   2. Wood
   3. Metal surfaces
c. Pigments and vehicles
   1. Paint
   2. Thinner
   3. Water emulsion paints
   4. Acrylic and polyvinyl paints
d. Common interior paints
   1. Ester grim
   2. Alkyl
   3. Pheolic
   4. Epoxy
   5. Silicone
   6. Latex
   7. Synthetic rubber
e. Solvent safety
   1. Ventilation
   2. Skin contact
   3. Flame
   4. Personal injury and damage to equipment
f. Primer selection
   1. Substrate material
   2. Surface condition
   3. Type of finish to be applied
   4. Cathodic protection
g. Surface coating selection
   1. Substrate
   2. Surface conditions

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Smith, Materials of Construction

Student Manuals:

Plant Engineering Training Systems, Non-metal Materials, Lesson Six

Tools and Equipment:

a. Paints
b. Primers
c. Brushes
d. Rollers
e. Sprayers

(Continued on back)

CLASSROOM HOURS

10

EVALUATION (MI-06)

Given a material to paint, the student will select a primer, a surface coating and a method of application. The student will identify and observe all safety precautions. Tasks must comply with the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

    3. Select coating
    4. Method of application
    5. Prepare surface
h. Surface preparation
    1. Wood
    2. Metal
    3. Masonry
i. Methods of application
    1. Brush
    2. Roller
    3. Spraying
    4. Dip
j. Zinc coating
k. Using colors
l. Speciality coatings
m. Paint terminology

INSTRUCTIONAL MATERIALS

Tools and Equipment:

f. Wire brush
g. Sander
h. Thinner
i. Paint stirring rod or paddle

Provide Demonstration On:

a. Selecting a primer
b. Selecting a surface coating
c. Selecting a method of application

Provide Practical Application On:

Select a primer, surface coating and method of application to paint a given surface.

TASK

MI-07 Identifying insulating materials and their applications

PERFORMANCE OBJECTIVE

Identify insulating materials and their applications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. How insulation works
b. Heat transfer
    1. Conduction
    2. Convection
    3. Radiation
c. Thermal insulating materials
d. Roll and batt insulation
e. Loose fill insulation
f. Low density insulation applications
g. Special insulation for extreme temperatures
h. Accoustical insulation
i. Sound absorbing materials
j. Vapor barriers
    1. Flame resistant jacket
    2. Low pressure or universal jacket
    3. Coatings
k. Electrical insulation
l. Fire barriers

INSTRUCTIONAL MATERIALS

Textbooks:

Smith, Materials of Construction

Student Manuals:

Plant Engineering Training Systems, Non-Metal Materials, Lesson Seven

CLASSROOM HOURS 10

EVALUATION (MI-07)

Given an application which requires insulation, the student will accurately identify an insulator and describe its application.

TASK

MI-08 Identifying properties and applications of construction materials

PERFORMANCE OBJECTIVE

Identify properties and applications of construction materials.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Inspection of construction materials
b. Concrete
    1. Applications
    2. Hydration
    3. Types of cement
    4. Aggregates
c. Mixing
d. Defects
    1. Spalling
    2. Crazing
    3. Dusting
e. Stain removal
f. Patching and repairs
g. Masonry products
    1. Concrete masonry
    2. Concrete block
h. Bricks
    1. Face brick
    2. Building a common brick
    3. ASTM grades
i. Mortar
    1. ASTM classifications
    2. Repointing
k. Wallboard repairs
l. Plaster
    1. Plaster of paris
    2. Hard-wall plaster
    3. Hard-finish plaster
    4. Special plaster
m. Glass
    1. Glass block
    2. Plastic glazing

INSTRUCTIONAL MATERIALS

Textbooks:

a. Dezettel, Masons and Builders Library
b. Smith, Materials of Construction

A/Vs:

DCA Educational Products, Transparencies BSM-1 through BSM-15; BSM-51 through BSM-57; "Brick and Stone Masonry"

Student Manuals:

Plant Engineering Training Systems, Non-metal Materials, Lesson Eight

CLASSROOM HOURS 15

EVALUATION (MI-08)

Given specifications for an industrial construction application, the student will accurately identify all the materials to be used and describe their properties.

TASK

MI-09 Identifying properties and applications of wood

PERFORMANCE OBJECTIVE

Identify properties and applications of wood.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Lumber industry
    1. Headrig
    2. Edger
    3. Kilns
b. Wood properties
    1. Hardwoods
    2. Softwoods
    3. Lignin
c. Wood grades
    1. Select
    2. Common
d. Hardwood grades
    1. Firsts
    2. Seconds
    3. Sweet
    4. Common
e. Wood defects
    1. Knots
    2. Checks
    3. Splits
    4. Warp
    5. Crown
f. Lumber measurements
    1. Running or linear feet
    2. Board feet
g. Plywood
    1. Veneer
    2. Exterior grade
    3. Interior grade
h. Choosing a wood
i. Wood frame construction
j. Wooden stains
    1. Rise
    2. Run
    3. Threads
    4. Risers
    5. Stringers

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Smith, Materials of Construction

A/Vs:

Hobar, Transparencies WT-set 1, "Wood Technology"

Student Manuals:

Plant Engineering Training Systems, Non-metal Materials, Lesson Nine

CLASSROOM HOURS

15

EVALUATION (MI-09)

Given specifications for a job, the student will accurately select the appropriate type of lumber and the proper number of board feet.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

k. Wood joints

l. Preservation and protection of wood
   1. Fillers or sealers
   2. Stains

m. Industrial applications
   1. Tanks and vats
   2. Ladders
   3. Stairs
   4. Decks and floors
   5. Scaffolding

n. Fasteners
   1. Glues
   2. Adhesives
   3. Nails
   4. Screws

Provide Demonstration On:

Selecting appropriate type and quantity of wood

Provide Practical Application On:

Select the appropriate wood and the proper number of board feet.

TASK

MI-10 Identifying adhesives and tapes

PERFORMANCE OBJECTIVE

Identify adhesives and tapes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Adhesives
    1. Assembly time
    2. Bond
    3. Cure
    4. Dry
    5. Harden
    6. Joint
    7. Pot life
    8. Set
    9. Shelf life
    10. Tuck
    11. Working time
b. General characteristics
    1. Liquids
    2. Pastes
    3. Mastic
    4. Two-part adhesives
    5. Thermosetting adhesives
c. Animal glues
d. Casein glues
e. Vegetable glues
f. Synthetic resin glues
g. Repairs with plastic resin adhesives
h. Plastic welding
i. Acrylic based adhesives
j. Special adhesives
    1. Structural adhesives
    2. Anaerobic adhesives
k. Tapes
    1. Masking tape
    2. Duct-seal tape
    3. High-temperature tape
    4. Freezer tape
    5. Double-coated tape
    6. Heat-shrikable tape
    7. Foam-backed tape

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Smith, Materials of Construction

Student Manuals:

Plant Engineering Training Systems, Non-Metal Materials, Lesson Ten

CLASSROOM HOURS

10

EVALUATION (MI-10)

Given a material that requires bonding, the student will select the appropriate adhesive or tape and describe the process which completes the bond. The completed task must be in compliance with the instructor's specifications.

INSTRUCTIONAL MATERIALS

Provide Demonstration On:

Applying adhesive and tape

Provide Practical Application On:

Select an adhesive or tape and apply it for a given job.

TASK

MI-11 Identifying the physical structure of metals

PERFORMANCE OBJECTIVE

Identify the physical structure of metals.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Definition of a metal
   1. Lustrous appearance
   2. Conductivity
   3. Number of metals in existence
b. Metallurgy
   1. Ores
   2. Chemical metallurgy
   3. Physical metallurgy
c. Properties of metals
   1. Strength
   2. Malleability
   3. Ductility
   4. Toughness
   5. Elasticity
   6. Ferromagnetic
   7. Thermocouple
d. Melting point of metals
   1. Definition
   2. Latent heat of fusion
e. Arrangement of atoms in metals
   1. Space lattice or geometric crystal structure
   2. Hexagonal close packed space lattice
f. Crystal formation
g. Composition of alloys
h. Nonferrous alloys
i. Cadmium
j. Cobalt
k. How metals are cast
l. Metal working
m. How metals are joined

INSTRUCTIONAL MATERIALS

Textbooks:

a. Feirer, Metalwork
b. Harold V. Johnson, Technical Metals

Student Manuals:

Plant Engineering Training Systems, Metal Materials, Lesson One

CLASSROOM HOURS 10

EVALUATION (MI-11)

Given a metal, the student will correctly identify its physical structure in terms of appearance, conductivity, malleability and melting point.

TASK

MI-12 Identifying properties of metals

PERFORMANCE OBJECTIVE

Identify properties of metals.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Mechanical properties
   1. Hardness
   2. Ductility
   3. Machinability
   4. Tensile strength
b. Stress
c. Kinds of stress
   1. Tension
   2. Compression
   3. Shear
d. Elasticity
   1. Elastic limit
   2. Ultimate breaking strength
e. Strain
f. Metal fatigue
g. Causes of failure
   1. Elastic breakdown
   2. Creep failures
h. Useable strength of metal
i. Heat and temperature
   1. Friction
   2. Motion of molecules
   3. Transfer of heat
   4. Heat and cold
j. Expansion of metals
k. Density
l. Specific gravity

Provide Demonstration On:

Figuring tensile strength

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Feirer, Metalwork
b. Harold V. Johnson, Technical Metals

Student Manuals:

Plant Engineering Training Systems, Metal Materials, Lesson Two

CLASSROOM HOURS 10

EVALUATION (MI-12)

Given a metal, the student will correctly identify its basic properties and figure tensile strength for a specified area and force.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

Figure tensile strength.

TASK

MI-13 Identifying methods of heat treatment .

PERFORMANCE OBJECTIVE

Identify methods used to heat treat metals.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Metallurgy and heat treatment
- b. Principles of heat treating
- c. Equilibrium diagrams
- d. Transformation of temperatures
- e. Iron-carbon phase diagram
  - 1. Liquidous line
  - 2. Solidous line
  - 3. Eutectic point
  - 4. Austenite
  - 5. Delta ferrite
  - 6. Alpha ferrite
  - 7. Euthectoid
  - 8. Pearlite
- f. Effects of heating, holding, cooling
- g. Isothermal transformation
  - 1. S-curve or TTT diagram
  - 2. Pearlite
  - 3. Bainite
  - 4. Martensite
- h. Heat treating ferrous metals
  - 1. Hardening
  - 2. Tempering
  - 3. Annealing
  - 4. Normalizing
  - 5. Spheroidizing
  - 6. Casehardening

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Feirer, Metalwork
- b. Harold V. Johnson, Technical Metals

Student Manuals:

Plant Engineering Training Systems, Metal Materials, Lesson Three

CLASSROOM HOURS 15

EVALUATION (MI-13)

Given a specified heat treatment process for metals, the student will identify and describe the process in terms of the properties of the metal.

TASK

MI-14 Identifying metal manufacturing processes

PERFORMANCE OBJECTIVE

Identify metal manufacturing processes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Methods of casting
  1. Sand
  2. Centrifugal
  3. Permanent-mold
  4. Die
b. Permanent-mold casting
c. Centrifugal casting
  1. Application
  2. Procedure
d. Die casting
  1. Hot chamber
  2. Cold chamber
e. Die forging
f. Extrusion
  1. Procedure
  2. Advantages
g. Cold forging steel
  1. Upsetting or heading
  2. Header
  3. Applications
h. Processing metal powders
  1. Electroforming
  2. Powder metallurgy
  3. Metal powder products
i. Stretching, shearing, bending
j. Wire drawing
  1. Meterial used
  2. Pickling
  3. Sulling

INSTRUCTIONAL MATERIALS

Textbooks:

a. Feirer, Metalwork
b. Harold V. Johnson, Technical Metals

A/Vs:

Career Aids, Inc.,
Filmstrip BX506,
"Foundry Work"

Student Manuals:

Plant Engineering Training Systems, Metal Materials, Lesson Four

CLASSROOM HOURS

15

EVALUATION (MI-14)

Given a specified metal manufacturing process, the student will identify the process, describe the steps in the process and identify the purpose of the process in terms of products.

TASK

MI-15 Identifying iron manufacturing processes

PERFORMANCE OBJECTIVE

Identify processes used to produce iron.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Iron ore
b. Making pig iron
    1. Pigs
    2. Pig molds
    3. Smelting
    4. Reduction
    5. Charging the blast furnace
c. Making cast iron
    1. Categories of iron-carbon alloys
    2. Elements in cast iron
    3. Advantages of cast iron
    4. Cupola
    5. Cementite
d. Gray cast iron
    1. Characteristics
    2. Applications
e. White cast iron
    1. Characteristics
    2. Applications
f. Malleable cast iron
    1. Characteristics
    2. Applications
g. Ductile cast iron
    1. Characteristics
    2. Applications
h. Producing steel from iron
    1. Open-hearth process
    2. The bessemer process
    3. Basic oxygen process
    4. Electric furnace process

INSTRUCTIONAL MATERIALS

Textbooks:

a. Feirer, Metalwork
b. Harold V. Johnson, Technical Metals

Student Manuals:

Plant Engineering Training Systems, Metal Materials, Lesson Five

CLASSROOM HOURS 15

EVALUATION (MI-15)

Given specifications for a type of iron and steel, the student will identify and describe the processes used to produce the iron and steel. The student will identify the characteristics and applications of the metal. The completed tasks must be in accordance with the instructor's specifications.

TASK

MI-16 Identifying processes used to product steel

PERFORMANCE OBJECTIVE

Identify processes used to produce steel.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Carbon steels
   1. Points
   2. Low carbon steel
   3. Medium carbon steel
   4. High carbon steel
b. Rolling steel
   1. Ingots
   2. Blooms, billets on slabs
c. Steel forms
   1. Plate
   2. Sheet
   3. Strip
   4. Bars
   5. Hot-rolled
   6. Cold-drawn
   7. Cast
d. Hot-rolled steel sheet
   1. Commercial quality (CQ)
   2. Drawing quality (DQ)
   3. Physical quality (PQ)
e. Cold-rolled steel sheets
f. Hot-rolled carbon steet strips
g. Cold-rolled carbon steet strips
h. Carbon steel plates
i. Carbon steel bars
j. Structrual steel
k. Constructional grade and tool steels
l. Stainless steel
   1. Austenitic
   2. Ferritic
   3. Martensitic

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Feirer, Metalwork
b. Harold V. Johnson, Technical Metals

Student Manuals:

Plant Engineering Training Systems, Metal Materials, Lesson Six

CLASSROOM HOURS 15

EVALUATION (MI-16)

Given a piece of steel which is coded, the student will identify the code, describe the process used to produce the steel and identify the application of the steel according to the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

m. Alloy steels
n. Steel classification
    1. SAE
    2. AISI
o. Steel color codes

Provide Demonstration On:

Identify steel codes.

Provide Practical Application On:

Identify the type of steel given and its code.

TASK

MI-17 Identifying processes used to produce aluminum

PERFORMANCE OBJECTIVE

Identify processes used to produce aluminum.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Properties of aluminum
   1. Low density
   2. High strength
   3. Electrical conductor (EC) grade
   4. Easy to fabricate
   5. Non-magnetic and non-sparking
b. Production of aluminum
c. Aluminum based alloys
   1. Wrought grades
   2. Casting grades
d. Wrought alunimum grades
   1. Aluminum association designation system
   2. Temper designation
e. Aluminum casting grades
   1. Aluminum association system
   2. Codes for heat-treatable casting alloys
f. Alloying elements
   1. Copper
   2. Silicon
   3. Magnesium
   4. Non-impurities
   5. Zinc, nickel and tin
g. Forming processes
   1. Forging
   2. Powder metallurgy
   3. Cladding
h. Anodizing
   1. Purpose
   2. Industrial applications

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Feirer, Metalwork
b. Harold V. Johnson, Technical Metals

Student Manuals:

Plant Engineering Training Systems, Metal Materials, Lesson Seven

Tools and Equipment:

a. Torch
b. Aluminum
c. Solder
d. Flux
e. Steel wool or emery cloth
f. Solvent

CLASSROOM HOURS 15

EVALUATION (MI-17)

Given a section of aluminum, the student will identify the type and describe the process used to produce it. Using this section of aluminum, the student will solder a joint. The completed task must meet the instructor's requirements.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

i. Joining aluminum
    1. Welding
    2. Brazing
    3. Soldering
    4. Soldering safety

Provide Demonstration On:

Soldering aluminum

Provide Practical Application On:

Solder two pipes of aluminum together.

TASK

MI-18 Identifying processes for the production of magnesium and titanium

PERFORMANCE OBJECTIVE

Identify the processes for the production of magnesium and titanium.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Production of magnesium
    1. Magnesium flouride
    2. Magnesite
    3. Dolomite
    4. Carnallite
b. Extraction of magnesium
    1. Electrolytic method
    2. Carbothermic method
c. Alloying melting and refining magnesium
    1. Process
    2. Equipment
d. Alloying magnesium
e. Magnesium alloy designations
f. Magnesium casting alloys
    1. Magnesium-aluminum-manganese (AM)
    2. Magnesium-Aluminum-zinc (AZ)
    3. Magnesium-rare earth-zirconium (EK, EZ and ZE)
    4. Magnesium-zinc-zirconium (ZK)
    5. Magnesium-thorium-zirconium (HK, HZ and ZH)
g. Magnesium wrought alloys
h. Extrusion
i. Rolling
j. Forming
k. Machining
l. Magnesium fires and safety

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Feirer, Metalwork
b. Harold V. Johnson, Technical Metals

Student Manuals:

Plant Engineering Training Systems, Metal Materials, Lesson Eight

CLASSROOM HOURS 15

EVALUATION (MI-18)

Given a specification for magnesium, titanium or an alloy, the student will identify the metal, describe the process used to refine it and identify procedures used to join the metal. The completed task must meet the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

m. Joining magnesium
    1. Welds, rivets, bolts or screws
    2. TIG welding and MIG welding
n. Titanium
    1. Processing
    2. Comercially pure titanium
    3. Uses of titanium

TASK

MI-19 Identifying processes used to produce copper

PERFORMANCE OBJECTIVE

Identify processes used to produce copper.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Producing copper
   1. Ores
   2. Separating ore
   3. Blister copper
   4. Anodes
   5. Cathodes
b. Copper alloys
   1. Silver
   2. Baron
   3. Lithium
c. Machinability ratings
   1. Adding lead
   2. Naval brass
   3. Red brass
d. Electrical conductivity
e. Corrosion resistance
f. Annealing copper
g. Brass
   1. Yellow (cartridge) brass
   2. Muntz metal
   3. Admiralty brass
   4. Bronze
h. Phosphor bronze alloy
i. Nickel silver
j. Aluminum bronze
k. Other bronzes
   1. Manganese
   2. Silicon
   3. Bull bronze
   4. Nickel bronze
l. Beryllium copper
m. Cupro-nickel
n. Copper-alloy casting

INSTRUCTIONAL MATERIALS

Textbooks:

a. Feirer, Metalwork
b. Harold V. Johnson, Technical Metals

Student Manuals:

Plant Engineering Training Systems, Metal Materials, Lesson Nine

CLASSROOM HOURS 15

EVALUATION (MI-19)

Given specifications for copper, the student will identify the type of copper or alloy and describe the process used to produce the metal.

TASK

MI-20 Identifying processes used to produce lead, nickel, tin and zinc

PERFORMANCE OBJECTIVE

Identify processes used to produce lead, nickel, tin and zinc.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Properties of lead
    1. Corrosion resistance
    2. Dense
    3. Soft
    4. Low melting point
    5. Color
b. Production of lead
c. Available forms of lead
    1. Pig
    2. Ingot
    3. Piping and tubing
d. Forming and fabricating lead
e. Methods of joining lead
    1. Soldering
    2. Welding (burning)
f. Producing nickel
    1. Uses of nickel
    2. Alloys
g. Properties of tin
    1. Brightness
    2. Corrosion resistance
    3. Low melting point
    4. Malleable
    5. Other properties
h. Uses of tin in industry
i. Tin plate
j. Tin alloys
k. Solders
l. Babbitt
m. Bronze
n. Zinc
    1. Producing zinc
    2. Zinc coatings
    3. Zinc paints
    4. Zinc compounds
    5. Machining zinc

INSTRUCTIONAL MATERIALS

Textbooks:

a. Feirer, Metalwork
b. Harold V. Johnson, Technical Metals

Student Manuals:

Plant Engineering Training Systems, Metal Materials, Lesson Ten

CLASSROOM HOURS 15

EVALUATION (MI-20)

Given specifications for lead, nickel, tin and zinc, the student will identify the processes used to produce the metal and describe its properties and applications.

TASK

D-01 Hand lettering

PERFORMANCE OBJECTIVE

Hand letter titles, notes, lists and dimensions in uppercase Reinhardt style.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Lettering styles
b. Lettering strokes
c. Using and drawing guide lines
d. Ames lettering guide
e. Spacing of letters and words
f. Freehand lettering in industry

Provide Demonstration On:

a. Use of Ames lettering guide
b. Strokes in lettering
c. Unacceptable letter forms

Provide Practical Application On:

a. Dimensioning drawings
b. Lettering notes, titles and item lists on drawings

INSTRUCTIONAL MATERIALS

Textbooks:

a. French and Svensen
c. Giesecke-Mitchell
c. Spencer-Hill-Dygdon
d. Jensen and Helsel
e. French

A/Vs:

Barr Films, Filmstrip #75000, Drafting Series I, "Lettering"

Student Manuals:

Gerevas, Drafting Technology Problems

Tools and Equipment:

a. Ames lettering guide or equal
b. 6H and H grades lead pencils
c. Parallel bar
d. Drawing table
e. Drafting vellum
f. Ames lettering guide pamphlet

CLASSROOM HOURS

5

EVALUATION (D-01)

Using graded lead pencils, an Ames lettering guide, or the equivalent, a drafting table with parallel bar, hand lettering notes and a dimensions list, the student will hand letter titles in standard, vertical, uppercase, single-stroke, Reinhardt (or Gothic) style. All letters should be vertical, correctly formed and adequately spaced.

TASK

D-02 Freehand sketching

PERFORMANCE OBJECTIVE

Sketch objects freehand in isometric and oblique.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of freehand sketches
b. Using freehand sketching in industry

Provide Demonstration On:

a. Sketching boxes in isometric and oblique
b. Using the box construction method to sketch objects
c. Drawing lines
d. Drawing circles and arcs

Provide Practical Application On:

Sketching objects from life, from drawings and from memory

INSTRUCTIONAL MATERIALS

Textbooks:

a. French and Svensen
b. Giesecke-Mitchell
c. Spencer-Hill-Dygdon
d. Jensen and Helsel
e. French

Tools and Equipment:

a. Pencil or felt tip pen
b. Paper
c. A hard flat smooth service

CLASSROOM HOURS 10

EVALUATION (D-02)

Using a pencil or pen and paper, the student will sketch freehand isometric and oblique objects which contain straight and curved elements. Opposite edges should be parallel and relative dimensions should be proportional so that the sketch renders a true representation of the object.

TASK

D-03 Analyzing drawings for acceptable drafting practice

PERFORMANCE OBJECTIVE

Analyze drawings for acceptable drafting practice.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Parameters for grading acceptability of drafting work
b. Parameters for grading sheet

Provide Demonstration On:

Grading drawings using parameters for grading sheet

Provide Practical Application On:

Analyzing drawings for acceptable drafting practice

INSTRUCTIONAL MATERIALS

Textbooks:

a. Giesecke-Mitchell-Spencer
b. Hill-Dygdon
c. Jensen and Helsel
d. French
e. Spence
f. French and Svensen

Tools and Equipment:

Various drawings

CLASSROOM HOURS 5

EVALUATION (D-03)

Given various examples of drafting work, the student will analyze the drawing(s) using the following 13 parameters for acceptability in industry practices and for identifying areas of strengths and weaknesses.

1.	Lettering:	Freehand written communication using the proper strokes and style.
2.	Line Work:	Convention line symbolism. Used consistently throughout drawing.
3.	Correctness of Drawing Construction:	All items relating to conventional drawing practices and standards.
4.	Neatness:	Habitually clean and orderly.
5.	Clarity of Communication:	Can it be built from your drawing?
6.	Design:	To devise for a specific function or end.
7.	Creativity:	Having the quality of something created rather than imitated.
8.	Speed:	The rate at which a drawing is completed.
9.	Correctness of Scale and Dimensioning:	(Self Explanatory)
10.	Correctness of Symbolism:	Do the symbols comply with standards set forth for that specialized field?
11.	Correctness of Drawing:	Does the drawing supply the necessary graphic information in order that the object can be built?
12.	Style or Workmanship:	A consistent expression of quality coming from within the individual and displayed on the drawing.
13.	Professionalism:	The conduct, aims or qualities that characterize or mark a profession or a professional person, including attendance, attitude and personal commitment to the drawing.

TASK

D-04 Drawing plane figures

PERFORMANCE OBJECTIVE

Draw regular and irregular plane figures.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Drawing tangents
b. Regular plane
c. Figures

Provide Demonstration On:

a. Drawing arcs tangent to arcs and-or lines
b. Drawing parallel lines
c. Dividing plane elements into parts of equal size

Provide Practical Application On:

Drawing plane figures

INSTRUCTIONAL MATERIALS

Textbooks:

a. Giesecke-Mitchell
b. Spencer-Hill-Dygdon
c. Jensen and Helsel
d. French
e. Spence
f. French and Svensen

Tools and Equipment:

a. Drafting tools
b. Pencils
c. Drafting table (or board)
d. Drawing media

CLASSROOM HOURS 10

EVALUATION (D-04)

Given drafting tools and necessary equipment ahd supplies, the student will draw regular and irregular plane figues with tangents and corners correctly formed and elements the correct size and proportion. The finished drawing must be within the parameters of acceptable drafting practices.

TASK

D-05 Drawing with line contrast

PERFORMANCE OBJECTIVE

Prepare drawings differentiating line function by contrast of line weights.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The alphabet of lines
b. Reproducible lines

Provide Demonstration On:

a. Drawing lines of reproducible weights on vellum
b. Rotating pencil for consistency of line weight

Provide Practical Application On:

Drawing borderlines, object lines, cutting plane lines, extension lines, dimension lines, centerings

INSTRUCTIONAL MATERIALS

Textbooks:

a. Giesecke-Mitchell
b. Spencer-Hill-Dygdon
c. Jensen and Helsel
d. French
e. French and Svensen
f. Spence

Tools and Equipment:

Drafting tools

CLASSROOM HOURS 10

EVALUATION (D-05)

Using graded lead and vellum, the student will prepare drawings that are easy to read, that are reproducible and that show contrast between lines.

TASK

D-06 Drawing to scale

PERFORMANCE OBJECTIVE

Draw objects to scale.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Architects scale
b. Engineers scale
c. Drawing in proportion
d. Metric scales

Provide Demonstration On:

Using architects scale to measure fractions of a scale inch

Provide Practical Application On:

Drawing to scale

INSTRUCTIONAL MATERIALS

Textbooks:

a. Giesecke-Mitchell-Spencer
b. Hill-Dygdon
c. Jensen and Helsel
d. French
e. Spence
f. French and Svensen

Student Manuals:

Gerevas, Drafting Technology Problems

Tools and Equipment:

Drafting tools

CLASSROOM HOURS

15

EVALUATION (D-06)

Given a scale and drafting tools, the student will draw a scale drawing proportional to the true size of the object. All lengths should be correct to ± 1/32 (true size of error). The finished drawing must be prepared within the parameters of acceptable drafting practices.

TASK

D-07 Drawing in orthographic

PERFORMANCE OBJECTIVE

Make orthographic drawings of objects.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Communicating objects for manufacture
b. First and third angle projection
c. Picture planes

Provide Demonstration On:

Use of miter lines and projection in making drawings

Provide Practical Application On:

Making orthographic drawings of objects

INSTRUCTIONAL MATERIALS

Textbooks:

a. Giesecke-Mitchell
b. Spencer-Hill-Dygdon
c. Jensen and Helsel
d. French
e. Spence
f. French and Svensen

A/Vs:

Barr Films, Filmstrip, Drafting Series I, "Size Description"

Student Manuals:

Gerevas, Drafting Technology Problems

Tools and Equipment:

Drafting tools

CLASSROOM HOURS

10

EVALUATION (D-07)

Given basic drafting tools, the student will draw complete objects in orthographic that clearly and accurately communicate the shape of the object for manufacture. The drawing should be within the parameters of acceptable drafting practices.

TASK

D-08 Dimensioning

PERFORMANCE OBJECTIVE

Dimension drawings of objects.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Dimensioning for clarity
b. Lineweight of extension and dimension lines and center lines
c. Dimensioning systems
    1. Bilateral
    2. Unilateral
d. Use of center lines
e. Double dimensioning

Provide Demonstration On:

Making arrowheads drawing leader lines

Provide Practical Application On:

Dimensioning drawings

INSTRUCTIONAL MATERIALS

Textbooks:

a. Giesecke-Mitchell
b. Spencer-Hill-Dygdon
c. Jensen and Helsel
d. French
e. Spence
f. French and Svensen

A/Vs:

Barr Films, Filmstrip, Drafting Series I, "Size Description"

Student Manuals:

Gerevas, Drafting Technology Problems

Tools and Equipment:

Drafting tools

CLASSROOM HOURS

5

EVALUATION (D-08)

Using the unilateral or bilateral system of dimensioning, the student will dimension objects for manufacture without double dimensioning. The completed task must be within the parameters of acceptable drafting practices.

TASK

D-09 Drawing in isometric

PERFORMANCE OBJECTIVE

Draw isometric pictorials of objects.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Isometric drawing in industry
b. Axes angles
c. Isometric scale and true length in isometric box construction
d. Method
    1. Skeletal construction
    2. Drawing curves in isometric

Provide Demonstration On:

Drawing circles in isometric

Provide Practical Application On:

Making isometric drawings of objects

INSTRUCTIONAL MATERIALS

Textbooks:

a. Giesecke-Mitchell-Spencer
b. Hill-Dygdon
c. Jensen and Helsel
d. French
e. Spence
f. French and Svensen

A/Vs:

Barr Films, Filmstrip,
Drafting Series I,
"Isometric Drawing"

Student Manuals:

Gerevas, Drafting Technology Problems

Tools and Equipment:

Drafting equipment

CLASSROOM HOURS

10

EVALUATION (D-09)

Given drafting tools, the student will make an isometric drawing of an object that correctly communicates its shape. The drawing should be within the parameters of acceptable drafting practices.

TASK

D-10 Drawing auxiliary views

PERFORMANCE OBJECTIVE

Draw auxiliary and secondary auxiliary views of objects.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Using auxiliary views in industry
b. Drawing auxiliary views and secondary auxiliary views

Provide Demonstration On:

Using folding plane lines

Provide Practical Application On:

Drawing auxiliary views to clarify the graphical description of objects

INSTRUCTIONAL MATERIALS

Textbooks:

a. Hawk
b. Hoelscher, Springer and Dobrovolny
c. French and Vierck
d. Spence
e. Jensen

A/Vs:

Barr Films, Filmstrip, Drafting Series II, "Auxiliary Views"

Student Manuals:

Hawk, Descriptive Geometry

Tools and Equipment:

a. Drafting instruments from attached lists including dividers
b. Drawing table and parallel bar

CLASSROOM HOURS

10

EVALUATION (D-10)

Given basic instruments, the student will use the folding plane method to draw auxiliary and secondary auxiliary views that clarify the description of an object so that it may be manufactured correctly.

TASK

D-11 Drawing fundamental views

PERFORMANCE OBJECTIVE

Draw the fundamental views of lines and planes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Use of fundamental views
b. Finding the bearing of a line
c. Use of folding plane lines

Provide Demonstration On:

a. Using dividers to transfer points
b. Finding true length and slope of lines
c. Drawing planes as an edge and in their true size
d. Reading bearings of lines

Provide Practical Application On:

a. Determining the true length, slope and bearing of a line
b. Drawing the true size and shape and finding the true slope of planes

INSTRUCTIONAL MATERIALS

Textbooks:

a. Minor C. Hawk
b. Hoelscher, Springer and Dobrovolny
c. Luzadder
d. Warner and McNeary

Student Manuals:

Hawk, Descriptive Geometry

Tools and Equipment:

a. Drafting instruments
b. Drawing table
c. Parallel bar

CLASSROOM HOURS

10

EVALUATION (D-11)

Given basic drawing instruments, the student will use descriptive geometry to draw views that show the true length, slope and bearing of lines and views that show the true size, shape and slope of planes. Lengths should be measured correctly to ± 1/32" (full size of error) and angles to ± 30'.

TASK

D-12 Connecting skew lines

PERFORMANCE OBJECTIVE

Find the shortest connections or the shortest connection of given slope and bearing between skew lines.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Skew lines and clearances in industry
b. Level line method for showing plane as an edge

Provide Demonstration On:

The plane method of finding connections between skew lines
a. Finding the clearance between skew lines
b. Finding the shortest distance of given slope and bearing between skew lines

INSTRUCTIONAL MATERIALS

Textbooks:

a. Minor C. Hawk
b. Warner and McNeary

Student Manuals:

Hawk, Descriptive Geometry

Tools and Equipment:

a. Drafting tools
b. Parallel bar
c. Drawing table

CLASSROOM HOURS

5

EVALUATION (D-12)

Given basic drafting tools, the student will use descriptive geometry to find the clearance between skew lines or the shortest connection of a given slope. Bearing between skew lines should have lengths within ± 1/32" (full size of error) and angles correct to ± 30' accuracy.

TASK

D-13 Finding piercing points

PERFORMANCE OBJECTIVE

Use the edge view or two view method to locate the point where a plane is pierced by a line.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Piercing points in industry
b. Methods for locating piercing points
    1. Edge view
    2. Two view

Provide Demonstration On:

Using the two view method
1. Cutting plane method
2. Edge view method.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Minor C. Hawk
b. Warner and McNeary

Student Manuals:

Hawk, Descriptive Geometry

Tools and Equipment:

a. Drafting tools
b. Drawing board
c. Parallel bar

CLASSROOM HOURS 5

EVALUATION (D-13)

Given basic drafting instruments, the student will use the edge view or two view method to determine and show the correct visibility of where a line intersects or pierces a plane. Lengths should be within ± 1/32" (full size of error) and angles within ± 30' accuracy.

TASK

D-14 Drawing plane intersections

PERFORMANCE OBJECTIVE

Use the two view or edge view method to draw the intersection of two planes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Plane intersections and solid figures
b. Plane intersections in industry
c. Methods for drawing plane intersections
    1. Edge view
    2. Two view

Provide Demonstration On:

The two view method and the edge view method

Provide Practical Application On:

Drawing the intersection of two planes

INSTRUCTIONAL MATERIALS

Textbooks:

a. Giesecke, Mitchell, Spencer and Hill
b. Hawk, Minor C.
c. Hoelscher, Springer and Dobrovolny
d. Warner and McNeary

Student Manuals:

Hawk, Descriptive Geometry

Tools and Equipment:

a. Drafting tools
b. Drawing board
c. Parallel bar

CLASSROOM HOURS

10

EVALUATION (D-14)

Given basic drafting tools, the student will use the two view methods or the edge view method to draw the intersection of two planes into views showing proper third angle visibility. Lengths should be within ± 1/32" (full size of error) and angles within ± 30' accuracy.

TASK

D-15 Determining dihedral angle

PERFORMANCE OBJECTIVE

Determine the dihedral angle between two planes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Plane intersections and dihedral angles
b. Method for determining the dihedral angle - edge view

Provide Demonstration On:

Plane method of determining the dihedral angle

Provide Practical Application On:

Determining the dihedral angle between two planes

INSTRUCTIONAL MATERIALS

Textbooks:

a. Hawk
b. Hoelscher, Springer and Dobrovolny
c. Luzadder
d. Warner and McNeary

Student Manuals:

Hawk, Descriptive Geometry

Tools and Equipment:

a. Drafting tools
b. Drawing table
c. Parallel bar

CLASSROOM HOURS

10

EVALUATION (D-15)

Given drafting instruments, the student will use the plane or line method to determine the dihedral angle between two non-parallel planes. The determination must be within ± 30' accuracy.

TASK

D-16 Determining true length with revolution.

PERFORMANCE OBJECTIVE

Determine the true length of a line by the method of revolution.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Use of revolution in industry to find true lengths
b. The method of revolution

Provide Demonstration On:

Using revolution to find true length

Provide Practical Application On:

Finding the true length of a line using revolution

INSTRUCTIONAL MATERIALS

Textbooks:

a. Giesecke, Mitchell, Spencer, Hill and Dygdon
b. Hawk
c. Hoelscher, Springer and Dobrovolny
d. Luzadder
e. Warner and McNeary

Student Manuals:

Hawk, Descriptive Geometry

Tools and Equipment:

a. Drafting tools
b. Parallel bar
c. Drawing table

CLASSROOM HOURS

10

EVALUATION (D-16)

Given drafting tools, the student will use the method of revolution to determine the true length of a line from two given views. The determination must be within ± 1/32" accuracy.

TASK

D-17 Drawing intersecting solids

PERFORMANCE OBJECTIVE

Use the two view method or the edge view method to draw two views of intersecting solids.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The occurrence of intersecting solids in industry
b. Methods for drawing intersecting solids
   1. Edge view
   2. Cutting plane

Provide Demonstration On:

Use of cutting plane to draw intersection

Provide Practical Application On:

Drawing intersecting solids

INSTRUCTIONAL MATERIALS

Textbooks:

a. French and Vierck
b. Hawk
c. Hoelscher, Springer and Dobrovolny
d. Jensen
e. Luzadder
f. Spence

Student Manuals:

Hawk, Descriptive Geometry

Tools and Equipment:

a. Drawing equipment
b. Parallel bars
c. Drawing table

CLASSROOM HOURS

10

EVALUATION (D-17)

Given drafting equipment, the student will use the two view or edge view method to show the correct visibility of two intersecting solids in two views.

TASK

D-18 Drawing developments

PERFORMANCE OBJECTIVE

Design and draw developments of objects.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

Sheet metal drafting

Provide Demonstration On:

Drawing stretchout or roll-outs

Provide Practical Application On:

Drawing developments

INSTRUCTIONAL MATERIALS

Textbooks:

a. Betterley
b. French and Vierck
c. Hawk
d. Hoelscher, Springer and and Dobrovolny
e. Jensen
f. Luzadder
g. Spence

Student Manuals:

Hawk, Descriptive Geometry

Tools and Equipment:

Drafting tools

CLASSROOM HOURS

10

EVALUATION (D-18)

Given drafting tools, the student will use the stretchout or rollout method to design and draw developments of objects that can be cut out and folded to correctly form the object.

TASK

D-19 Drawing fasteners

PERFORMANCE OBJECTIVE

Draw and specify standard fasteners.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of threads
b. Representations of threads
   1. Detailed
   2. Simplified
   3. Schematic
c. Standard nomenclature for specifying fasteners
d. Standard fasteners: bolts, studs, screws, keys, rivets, washers and pins
e. Use of fastener tables

Provide Demonstration On:

Drawing fasteners and using standard tables

Provide Practical Application On:

Drawing and specifying fasteners (bolts, screws, studs, keys, rivets, pins and washers)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Coover and Helsel
b. French
c. Giesecke, Mitchell, Spencer, Hill and Dygdon
d. Luzadder
e. Jensen and Helsel
f. Spence

A/Vs:

Barr Films, Filmstrip, Drafting Series II, "Fasteners"

Student Manuals:

a. Coover and Helsel, Programmed Blueprint Reading
b. Gerevas, Drafting Technology Problems

Tools and Equipment:

a. Drafting tools
b. Fastener tables

CLASSROOM HOURS 10

EVALUATION (D-19)

Given standard tables and using standard nomenclature and graphic representation, the student will correctly draw and specify fasteners.

TASK

D-20 Drawing welds

PERFORMANCE OBJECTIVE

Draw and specify welds.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Welding processes
b. Welding symbols
c. Types of welds

Provide Demonstration On:

Finding and drawing correct weld symbols

Provide Practical Application On:

Drawing and specifying welding symbols

INSTRUCTIONAL MATERIALS

Textbooks:

a. French
b. French and Svensen
c. Giesecke, Mitchell, Spencer, Hill and Dygdon
d. Jensen and Helsel
e. Luzadder
f. Spence

Student Manuals:

Gerevas, Drafting Technology Problems

Tools and Equipment:

Drafting equipment

CLASSROOM HOURS 10

EVALUATION (D-20)

Given reference materials and using standard symbols and nomenclature, the student will draw and specify welds. The drawing and specifications must be within the parameters of acceptable drafting practices.

TASK

D-21 Dimensioning tolerances

PERFORMANCE OBJECTIVE

Use standard nomenclature to dimension tolerances.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of fits
b. Specifications for fits
c. Fit tables
d. Specifying allowances
e. Geometric tolerances and specifications symbols
f. Tolerancing for location

Provide Demonstration On:

Use of tolerancing fit tables

Provide Practical Application On:

Specifying tolerances

INSTRUCTIONAL MATERIALS

Textbooks:

a. French
b. French and Svensen
c. Giesecke, Mitchell, Spencer, Hill and Dygdon
d. Luzadder
e. Spence

Student Manuals:

a. Coover and Helsel, Programmed Blueprint Reading
b. Gerevas, Drafting Technology Problems

Tools and Equipment:

Tolerancy fit tables

CLASSROOM HOURS 5

EVALUATION (D-21)

Given tolerancing tables and reference materials, the student will specify tolerances using standard symbols and nomenclature.

TASK

D-22 Drawing gears

PERFORMANCE OBJECTIVE

Draw and specify gears using standard symbolism and nomenclature.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of gears
b. Methods for drawing or representing gears
c. Gear formulas

Provide Demonstration On:

Drawing involutes calculating gear data using formulas

Provide Practical Application On:

Drawing gears

INSTRUCTIONAL MATERIALS

Textbooks:

a. French
b. French and Svensen
c. Giesecke, Mitchell, Spencer, Hill and Dygdon
d. Jensen and Helsel
e. Luzadder
f. Spence

Student Manuals:

Gerevas, Drafting Technology Problems

Tools and Equipment:

Drafting tools

CLASSROOM HOURS

15

EVALUATION (D-22)

Given gear data and formulas, the student will draw and specify gears using standard symbols and nomenclature. The completed task must be within the parameters of acceptable drafting practices.

TASK

D-23 Drawing cams

PERFORMANCE OBJECTIVE

Draw plate cams to generate specific follower motion.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Cam motions
   1. Uniform
   2. Modified uniform
   3. Parabolic
   4. Harmonic
   5. Cycloidal
   6. Trapezoidal
   7. Modified sine

b. Cam followers

Provide Demonstration On:

Drawing and using motion diagrams using French curve

Provide Practical Application On:

Drawing cams with specified motion and follower

INSTRUCTIONAL MATERIALS

Textbooks:

a. French
b. French and Svensen
c. Giesecke, Mitchell, Spencer, Hill and Dygdon
d. Jensen and Helsel
e. Luzadder
f. Spence

Student Manuals:

Gerevas, Drafting Technology Problems

Tools and Equipment:

Drafting tools

CLASSROOM HOURS

15

EVALUATION (D-23)

Given desired follower motion and type, the student will draw a plate cam that will correctly and smoothly generate motion and communicate the cam shape. The work must reflect the parameters of acceptable drafting practices (lettering, line work, neatness, clarity, correctness of scale and dimensioning and correctness of symbolism).

TASK

D-24 Drawing details

PERFORMANCE OBJECTIVE

From a working drawing, draw details of elements for manufacture.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Use of detail drawings in industry
b. Mark number systems
c. Typical materials list

Provide Practical Application On:

Drawing details from assembly and working drawings and findings dimensions on working drawings

INSTRUCTIONAL MATERIALS

Textbooks:

a. French
b. French and Svensen
c. Giesecke, Mitchell, Spencer, Hill and Dygdon
d. Jensen and Helsel
e. Luzadder
f. Spence

A/Vs:

Barr Films, Filmstrip, Drafting Series II, "Assembly and Detail Drawings"

Student Manuals:

Gerevas, Drafting Technology Problems

Tools and Equipment:

Drafting tools

CLASSROOM HOURS

10

EVALUATION (D-24)

Given working drawing or sketches, the student will draw details of elements for manufacture. The drawings must be within the parameters of acceptable drafting practices.

TASK

D-25 Drawing assemblies

PERFORMANCE OBJECTIVE

Draw assembly drawings of a system with more than one element.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Use of assembly drawings
b. Dimensioning of assembly drawings
c. Types of assembly drawings and their uses:
    1. Orthographic
    2. Pictorial
    3. Exploded

Provide Practical Application On:

Drawing assembly drawings

INSTRUCTIONAL MATERIALS

Textbooks:

a. French
b. French and Svensen
c. Giesecke, Mitchell, Spencer, Hill and Dygdon
d. Jensen and Helsel
e. Luzadder
f. Spence

A/Vs:

Barr Films, Filmstrip, Drafting Series II, "Assembly and Detail Drawings"

Student Manuals:

Gerevas, Drafting Technology Problems

Tools and Equipment:

Drafting tools

CLASSROOM HOURS 10

EVALUATION (D-25)

Given working drawings or sketches, the student will draw assembly drawings showing relative location of distinct elements making up the assembly. The drawings must be within the parameters of acceptable drafting practices.

TASK

D-26 Drawing charts

PERFORMANCE OBJECTIVE

Design and draw charts that communicate relative data.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of charts
b. Use of charts
c. Chart media
d. Mechanically aided lettering
e. Dry transfers

Provide Demonstration On:

Designing a chart

Provide Practical Application On:

Designing and drawing charts

INSTRUCTIONAL MATERIALS

Textbooks:

a. French
b. Giesecke, Mitchell, Spencer, Hill and Dygdon
c. Jensen and Helsel
d. Luzadder
e. Spence

Student Manuals:

Gerevas, Drafting Technology Problems

Tools and Equipment:

Drafting tools

CLASSROOM HOURS 10

EVALUATION (D-26)

Given a sketch or a list of data, the student will draw charts that clearly communicate the relative size of items. The charts must be within the parameters of acceptable drafting practices.

TASK

D-27 Drawing graphs

PERFORMANCE OBJECTIVE

Draw graphs of functions which show changing data.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Use of graphs in engineering
b. Conic sections
c. Types of graphs
d. Scale of coordinates

Provide Demonstration On:

Plotting points and connecting them with French curves

Provide Practical Application On:

Drawing graphs

INSTRUCTIONAL MATERIALS

Textbooks:

a. Giesecke, Mitchell, Spencer, Hill and Dygdon
b. Luzadder

Tools and Equipment:

Drafting tools

CLASSROOM HOURS 10

EVALUATION (D-27)

Given a set of ordered pairs of data or a relationship between ordered pairs of data, the student will draw a graph that accurately and clearly shows the relationship for all members of the set within the range of interest. All work must be within the parameters of acceptable drafting practices.

TASK

D-28 Sketching designs

PERFORMANCE OBJECTIVE

Sketch objects or assemblies to communicate mechanical design concepts.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Use of design sketching in industry
b. Methods of sketching in proportion

Provide Demonstration On:

Sketching using the box construction method

Provide Practical Application On:

Sketching designs of objects and assemblies

INSTRUCTIONAL MATERIALS

Textbooks:

a. Giesecke, Mitchell, Spencer, Hill and Dygdon
b. Jensen
c. Luzadder

Tools and Equipment:

a. Paper
b. Hard surface
c. Pencil

CLASSROOM HOURS

10

EVALUATION (D-28)

Given a design concept for a mechanical element or system, the student will sketch a freehand graphic representation of a design that: (1) clearly shows the design for evaluation of the concept, and (2) is within the parameters of good drafting practices.

TASK

D-29 Drawing sections

PERFORMANCE OBJECTIVE

Draw sections of objects showing interior or obscure detail.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Use of sections in industry
b. Types of sections
c. Material designation
d. Locating section
e. Views on drawings
f. Items not cross-hatched
g. Drawing cutting plane lines

Provide Demonstration On:

Drawing crosshatching

Provide Practical Application On:

Drawing sections to clarify obscure detail

INSTRUCTIONAL MATERIALS

Textbooks:

a. French
b. French and Svensen
c. Giesecke, Mitchell, Spencer, Hill and Dygdon
d. Jensen and Helsel
e. Spence

A/Vs:

Barr Films, Filmstrip, Drafting Series I, "Sections"

Student Manuals:

Gerevas, Drafting Technology Problems

Tools and Equipment:

Drafting tools

CLASSROOM HOURS

10

EVALUATION (D-29)

Given an orthographic drawing, the student will draw a section view which clearly shows interior detail or cross section obsecured in the drawing. The drawing quality must be within the parameters of acceptable drafting practices.

TASK

MP-01 Laying out metal surfaces

PERFORMANCE OBJECTIVE

Layout a metal surface by marking or scribing center points, circles, arc or straight lines.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Tools used for laying out and scribing lines
b. Scribers
    1. Construction
    2. Keeping the point sharp
c. Kinds of mixtures which produce a white coating
d. Copper sulphate solution
e. Blueing a steel surface
f. Cleanliners
g. Laying out angular lines
h. Grinding points of punches
    1. Center punch
    2. Prick punch
i. Using dividers
j. Using hermaphrodite calipers

(Continued on back)

Provide Demonstration On:

a. Marking a metal surface
b. Scribing a metal surface
c. Locating the center point on round stock

Provide Practical Application On:

a. Use a scriber to mark a circle, arc and straight line on a metal surface.
b. Locate and mark the center point on round stock.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Porter

A/Vs:

a. Bergwall, Filmstrip #505, "Bench Metal Work"
b. Prentice-Hall, Filmstrip #VD930-1, "Machine Shop: Bench Operations"

Student Manuals:

Ohio, Machine Trades I, Bench-Work Assignment Sheet #1

Tools and Equipment:

a. Scribing tools
b. Marking supplies
c. American Machinist's Handbook
d. Machinery Handbook

CLASSROOM HOURS 5

EVALUATION (MP-01)

a. Given appropriate tools, supplies and equipment, the student will accurately layout metal work by scribing or marking circles, arcs and straight lines and marking the center point of round stock.

b. V'TECS, Machine Shop, Task No. 22.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

k. Surface plate
l. Use of Vee blocks
m. Centering round stock
    1. Methods
    2. Tools used

TASK

MP-02 Identifying jig buttons

PERFORMANCE OBJECTIVE

Identify the purpose of jig buttons and the method of spacing holes in circles.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Jig buttons
   1. Purpose
   2. Location on the work
   3. Instruments used to set buttons
   4. Tightening the screws
b. Using the parallel and micrometer
c. Using the height gage
d. When jig buttons are removed
e. Laying out equally spaced holes on a circle

Provide Demonstration On:

a. Setting jig buttons
b. Laying out equally spaced holes on a circle

Provide Practical Application On:

a. Locating and setting jig buttons.
b. Layout equally spaced holes on a circle.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

Student Manuals:

Ohio, Machine Trades I, Bench-Work Assignment Sheet #2

Tools and Equipment:

a. American Machinist's Handbook
b. Jig button
c. Screw
d. Washer
e. Parallel
f. Micrometer
g. Height gage

CLASSROOM HOURS

5

EVALUATION (MP-02)

Given appropriate tools, supplies and equipment, the student will layout and correctly set jig buttons and accurately layout equally spaced holes in a given size circle.

TASK

MP-03 Using the sine bar

PERFORMANCE OBJECTIVE

Use the sine bar to check angles, bevels and tapers pertaining to templates, gauges and other angular work.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Sine bar
    1. Purpose
    2. Method of use
    3. Construction (kind of steel)
b. Sine bar application
    1. Items that can be checked
    2. Jo-block
c. Trigonometric functions
    1. Formula
    2. Right triangle
d. Adjustable angle plates

Provide Demonstration On:

a. Using the trigonometry formula for setting the sine bar
b. Measuring an angle with the sine bar

Provide Practical Application On:

a. Sketch a surface plate with a two-inch Jo-block and an angle plate mounted with a five inch sine bar.
b. Measure an angle using the sine bar.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Porter

A/Vs:

Bergwall, Filmstrip #503, "Measuring Tools Explained"

Student Manuals:

a. Ohio, Machine Trades I, Bench Work Assignment Sheet #3
b. Machine Shop Training Course, Vol. 1

Tools and Equipment:

a. American Machinist's Handbook
b. Machinery's Handbook
c. Sine bar
d. Jo-blocks

CLASSROOM HOURS

10

EVALUATION (MP-03)

a. Given an assigned measurement, the student will accurately measure an angle using the sine bar. The instructor will check the student's results for accuracy.

b. V'TECS, Machine Shop, Task No. 40.

TASK

MP-04 Using the bevel protractor

PERFORMANCE OBJECTIVE

Use a bevel protractor to make an assigned relative measurement.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Bevel protractor
   1. Application
   2. Maximum revolution
   3. Valve of the divisions on the vernier scale
   4. Maximum reading on the scale

b. Measuring angles greater than 90°

Provide Demonstration On:

a. Reading the scale on a bevel protractor
b. Making a greater than 90° measurement

Provide Practical Application On:

a. Measure an angle and read the scale on the bevel protractor.
b. Measure an angle which is greater than 90°.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Bergwall, Filmstrip #503, "Measuring Tools Explained"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #4

Tools and Equipment:

Bevel protractor

CLASSROOM HOURS

5

EVALUATION (MP-04)

Given a bevel protractor and an assigned measurement, the student will accurately read the measurement. The measurement may be of an angle which is greater than 90°.

TASK

MP-05 Using steel rules

PERFORMANCE OBJECTIVE

Use steel rules to make measurements.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of steel rules
b. Types of scales on the rule
c. Reading the scales
d. Using a short length rule
e. Adding fractions
f. Reducing a fraction to lowest terms

Provide Demonstration On:

a. Using a short length rule
b. Adding fractions
c. Reducing fractions to lowest terms

Provide Practical Application On:

Use a steel rule to make an assigned measurement.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, Filmstrip #501-1, "Bench Metal Work"
b. Prentice-Hall, Filmstrip #VD930-1, "Machine Shop: Bench Operations"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #5

Tools and Equipment:

Steel ruler

CLASSROOM HOURS 5

EVALUATION (MP-05)

Given a steel rule and an assigned measurement, the student will make the measurement to an accuracy of 1/64 inch and reduce the fractional reading to lowest terms. The instructor will check the student's reading.

TASK

MP-06 Using the micrometer

PERFORMANCE OBJECTIVE

Identify types and use micrometers to measure inside and outside diameters, threads, depth of holes and surfaces.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of micrometers
   1. Screw thread micrometer
   2. Outside micrometer
   3. Inside micrometer
   4. Micrometer depth gages
b. Care and maintenance of micrometers
c. Using micrometers
d. Temperature factors
e. Parts of a standard micrometer

Provide Demonstration On:

Using a micrometer to measure outside diameter and inside diameter

Provide Practical Application On:

Name the standard parts of a micrometer.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Bergwall, Filmstrip #503-2,3,4, "Measuring Tools Explained"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #6

Tools and Equipment:

Micrometer

CLASSROOM HOURS 15

EVALUATION (MP-06)

a. Given a micrometer and an assigned measurement, the student will read a measurement to an accuracy of three places. The student will identify and choose the appropriate micrometer to measure inside diameter, outside diameter, screw threads and depths.

b. V'TECS, Machine Shop, Task No. 19.

TASK

MS-07 Reading a vernier scale

PERFORMANCE OBJECTIVE

Read a vernier scale as applied to calipers and micrometers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Divisions of the vernier scale
b. Reading a scale
c. Reading a vernier micrometer
    1. Vernier reading
    2. Thimble reading

Provide Demonstration On:

a. Reading a vernier caliper
b. Reading a vernier micrometer

Provide Practical Application On:

Make assigned measurements with a vernier caliper and a vernier micrometer.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Bergwall, Filmstrip #503-1, "Measuring Tools Explained"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #7

Tools and Equipment:

a. Calipers (vernier)
b. Micrometers (vernier)

CLASSROOM HOURS

10

EVALUATION (MP-07)

Given a vernier caliper and a vernier micrometer, the student will make assigned measurements and read the scales to an accuracy of four places.

TASK

MP-08 Using dial indicators, center testers and speed indicators

PERFORMANCE OBJECTIVE

Use a dial indicator, center tester and speed indicator in bench work to set up and inspect work for roundness, concentricity and straight and parallel surfaces.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Dial indicators
b. Center testers
c. Speed indicators
d. The center punch mark
e. Types of graduations found on a dial indicator

Provide Demonstration On:

a. Using a dial indicator
b. Using a center tester
c. Using a speed indicator

Provide Practical Application On:

Use a dial indicator, center tester and speed indicator to set up and inspect work for roundness, concentricity and straight and parallel surfaces.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Bergwall, Filmstrip #503-5, "Measuring Tools Explained"

Student Manuals:

a. Ohio, Machine Trades I, Bench Work Assignment Sheet #8
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. American Machinist's Handbook
b. Dial indicators
c. Wigglers on center finders
d. Speed indicators

CLASSROOM HOURS

10

EVALUATION (MP-08)

a. Given a dial indicator, center tester and speed indicator, the student will correctly use these instruments to set up and inspect work for roundness, concentricity and straight and parallel surfaces.

b. V'TECS, Machine Shop, Task No. 36.

TASK

MP-09 Using precision gage blocks, tapered ring, plug and snap gages

PERFORMANCE OBJECTIVE

Use precision gage blocks in making accurate measurements and use the tapered ring, plug and snap gages.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Gage blocks
   1. Description
   2. Uses
   3. Sizes
b. Using gage block combinations
c. Using gage blocks to check micrometer accuracy
d. Using a taper gage (figuring the taper)
e. Using a snap gage
   1. Sizes
   2. Tolerance

Provide Demonstration On:

a. Using gage blocks
b. Using a taper gage
c. Using plug and snap gages

Provide Practical Application On:

a. Use a combination of gage blocks to check a measurement for accuracy.
b. Use a taper gage to calculate taper.
c. Use plug and snap gages to measure a given dimension.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Bergwall, Filmstrip #503-4, "Measuring Tools Explained"

Student Manuals:

a. Ohio, *Machine Trades I*, Bench Work Assignment Sheet #9
b. *Machine Shop Training Course*, Vol. I

Tools and Equipment:

a. Precision gage blocks
b. Tapered ring gage
c. Plug and snap gages
d. *American Machinist's Handbook*
e. Micrometer

CLASSROOM HOURS

10

EVALUATION (MP-09)

a. Given an assigned series of measurements, the student will properly use gage blocks, a taper gage and plug and snap gages to make accurate measurements.

b. V'TECS, Machine Shop, Task No. 37 and 38.

TASK

MP-10 Identifying and using hand hacksaws

PERFORMANCE OBJECTIVE

Identify and use hand hacksaws including types and sizes of blades.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Testing a material with a file prior to sawing
b. Saw blades
    1. Teeth-per-inch
    2. Types
    3. Tightening a blade
    4. Types, sizes
c. Using the vise (using pieces of wood for chips, pieces)
d. Layout line

Provide Demonstration On:

a. Installing a hacksaw blade
b. Using a hacksaw

Provide Practical Application On:

Choose a hacksaw blade, install it on a saw and cut an assigned piece of material.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, Filmstrip #502-2, "Bench Metal Work"
b. Prentice-Hall, Filmstrip #VD930-2, "Machine Shop: Bench Operations"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #10

Tools and Equipment:

a. Machinist's Handbook
b. Hacksaw
c. Vise
d. Hacksaw blades

CLASSROOM HOURS

5

EVALUATION (MP-10)

a. Given a hacksaw and a selection of blades, the student will select and install the appropriate blade to cut an assigned piece of metal and cut the metal to a specified dimension using appropriate hand hacksaw procedures.

b. V'TECS, Machine Shop, Task No. 28 and No. 41.

TASK

MP-11 Using abrasives and lapping compounds

PERFORMANCE OBJECTIVE

Use abrasives and lapping compounds to obtain a fine, smooth surface on hard or soft metal.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Abrasives
    1. Natural types
    2. Manufactured types
b. Laps of soft materials
c. Materials used for laps
d. Scoring or grooving laps
    1. Purpose
    2. Procedure
e. Lapping flat surfaces
f. Emery cloth
g. Buffing

Provide Demonstration On:

a. Lapping a surface
b. Smoothing a surface using emery cloth

Provide Practical Application On:

a. Lapping a surface
b. Using emery cloth to smooth a metal surface

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Bergwall, Filmstrip #501, "The Lathe Explained"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #11

Tools and Equipment:

a. American Machinist's Handbook
b. Machinery's Handbook
c. Emery cloth
d. Lapping compound
e. Vise

CLASSROOM HOURS

10

EVALUATION (MP-11)

Given a soft or hard metal surface, the student will obtain a fine and smooth surface using abrasives and lapping compound.

TASK

MP-12 Identifying and using files

PERFORMANCE OBJECTIVE

Identify the types, sizes and selection of files and be able to use them.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Single cut files
b. File teeth
c. File faces
d. 1/2 round files
e. The parts of a file
f. Double cut files

Provide Demonstration On:

Using a file

Provide Practical Application On:

Use a file on a given piece of material.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, Filmstrip #505-3, "Bench Metal Work"
b. Prentice-Hall, Filmstrip #VD930-2, "Machine Shop: Bench Operations"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #12

Tools and Equipment:

Files

CLASSROOM HOURS

5

EVALUATION (MP-12)

a. Given a piece of metal with a rough edge, the student will correctly select a file and smooth the edge following correct procedures.

b. V'TECS, Machine Shop, Task No. 33.

TASK

MP-13 Scraping flat and curved bearing surfaces

PERFORMANCE OBJECTIVE

Scrape flat and curved bearing surfaces for making smooth running machine parts and surface plates.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Materials used for surface plates
b. Purpose of scraping
c. Using a straight edge for scraping
    1. Procedure
    2. Purpose
d. Scrapers
    1. Materials made of
    2. Types of
e. Marking materials used in scraping
f. Figuring the list price of cast iron surface plate

Provide Demonstration On:

a. Scraping a surface plate
b. Calculating list price of cast iron surface plate

Provide Practical Application On:

Scrape bearing surfaces to smoothness.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Bergwall, Filmstrip #505-1, "Bench Metal Work"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #13

Tools and Equipment:

a. Scraper
b. Marking tools

CLASSROOM HOURS 10

EVALUATION (MP-13)

Given a bearing surface, the student will choose the appropriate tools and scrape the surface to smoothness.

TASK

MP-14 Using hammers and screwdrivers for hand bench use

PERFORMANCE OBJECTIVE

Use hammers and screwdrivers for hand bench use and observe all safety and maintenance procedures.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Main parts of a machinist's hammer
b. Hammer safety
c. Soft hammer heads
d. Types of hammers
e. Hammer handles
f. Screwdriver safety
g. Grinding a screwdriver
h. Choosing a screwdriver

Provide Demonstration On:

a. Tightening a hammer head
b. Grinding a screwdriver

Provide Practical Application On:

a. Use a hammer to ding a metal surface.
b. Grind a screwdriver head.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Bergwall, Filmstrip #505-6, "Bench Metal Work"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #14

Tools and Equipment:

a. Hammers
b. Screwdrivers
c. Grinding wheel

CLASSROOM HOURS 10

EVALUATION (MP-14)

Given a hammer and a screwdriver, the student will use the tools for an assigned task and observe correct procedures and safety practices.

TASK

MP-15 Identifying and using wrenches

PERFORMANCE OBJECTIVE

Identify the types, sizes and care of wrenches and be able to use them.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Wrenches
   1. Types
   2. Safety
   3. Leverage

b. Using an adjustable wrench

c. Holding and check nuts

d. Checking nut tightness

Provide Demonstration On:

Using wrenches

1. Open end
2. Box end
3. Adjustable
4. Spanner types

Provide Practical Application On:

Identify and properly use several different types of wrenches.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I

b. Kibbe

c. Porter

A/Vs:

Bergwall, Filmstrip #505-6, "Bench Metal Work"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #15

Tools and Equipment:

a. Wrenches

b. American Machinist's Handbook

c. Machinery's Handbook

CLASSROOM HOURS

5

EVALUATION (MP-15)

Given a selection of wrenches and an assigned nut to tighten, the student will select the appropriate wrench and follow safe procedures to tighten the nut.

TASK

MP-16 Using bench vises and clamps

PERFORMANCE OBJECTIVE

Use the bench vise or clamps to hold materials for bench work.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of vises
b. Kinds of metals vises are made of
c. False protective jaws
d. Parts of a bench vise
e. How a vise is fastened to a bench

Provide Demonstration On:

Fastening materials in a bench vise

Provide Practical Application On:

Use a bench vise to hold material for bench work operation.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #16

Tools and Equipment:

a. Machinery's Handbook
b. Bench vise or clamps

CLASSROOM HOURS

5

EVALUATION (MP-16)

Given a material to bend, chip, polish, file or perform other bench work on, the student will secure the material in a bench vise. The student will follow correct procedures and precautions.

TASK

MP-17 Identifying and using chipping tools

PERFORMANCE OBJECTIVE

Identify and use tools for chipping.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Angles between facets of a chisel
b. Types of chisels
c. Chipping guard
d. Chipping a keyway
e. Safety
f. Amount of material to leave for finishing

Provide Demonstration On:

a. Choosing a chisel for a job
b. Proper use of a chisel

Provide Practical Application On:

Use a chisel for an assigned chipping operation.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

Student Manuals:

a. Ohio, Machine Trades I, Bench Work Assignment Sheet #17
b. Machine Shop Training Course, Vol. 2

Tools and Equipment:

a. Chipping tools
b. Vise
c. Machinery's Handbook

CLASSROOM HOURS 10

EVALUATION (MP-17)

Given an assigned chipping to be done, the student will choose the correct type of chisel and use the chisel to chip the material to appropriate tolerances. The student will follow all procedures and safety precautions.

TASK

MP-18 Using hand taps, dies and hand reamers

PERFORMANCE OBJECTIVE

Use hand taps, dies and hand reamers to size, ream holes and cut threads.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Threads
    1. National Fine (N.F.)
    2. National Coarse (N.C.)
b. Tapering pipe taps
c. Bottom taps
d. Tap sets
e. Plug taps
f. Blind hole
g. Pulley tap
h. Tap drill
i. Tap drill sizing formula
j. Tap safety
k. Dies
    1. Threading dies
    2. Solid threading dies
    3. Adjustable die
    4. Die stock

(Continued on back)

Provide Demonstration On:

a. Checking a tap for square alignment with a hole
b. Using a tap set
c. Cut threads using a die set

Provide Practical Application On:

a. Tap a hole with a hand tap.
b. Cut threads with a hand die.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, Filmstrip #505-5, "Bench Metal Work"
b. Prentice-Hall, Filmstrip #VD930-4, "Machine Shop: Bench Operations"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #18

Tools and Equipment:

a. Hand taps
b. Dies
c. Reamers
d. American Machinist's Handbook
e. Machinery's Handbook
f. Squares

CLASSROOM HOURS 10

EVALUATION (MP-18)

a. Given a tap set and a hand die set, the student will tap threads in a hold and cut threads on a pipe or rod. The student will follow appropriate procedures and safety precautions.

b. V'TECS, Machine Shop, Task No. 57, 59 and 64.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

l. Chamfering a rod prior to threading
m. Lubrication
n. Major diameter and minor diameter
o. Safety

TASK

MP-19 Identifying power tool safety practices

PERFORMANCE OBJECTIVE

Identify safety procedures for using power tools in bench work.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of power tools
    1. Electrical
    2. Pneumatic
b. Electrical hazards
c. Mechanical hazards
d. Safety

Provide Demonstration On:

List safety rules for operation of:
1. Power drills
2. Impact wrenches
3. Power drivers
4. Polishes

Provide Practical Application On:

List safety rules for operation of:
1. Power drills
2. Impact wrenches
3. Power drivers
4. Polishers

INSTRUCTIONAL MATERIALS

Textbooks:

Tools and Their Uses

A/Vs:

Bergwall, Filmstrip #514, "Working with Power Tools and Machines"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #19

Tools and Equipment:

Safety posters

CLASSROOM HOURS

5

EVALUATION (MP-19)

Given several power tools used in the machine shop, the student will identify electrical and mechanical hazards associated with use of the tool and follow related safety practices.

TASK

MP-20 Assembling and fitting

PERFORMANCE OBJECTIVE

Make a drive, sliding, running and shrink fit for outside and inside measurements for gears, pulleys, bushings, shafts, spindles and threads.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Standard shafting
b. Tolerance
c. Precautions in making a press fit
d. Types/kinds of running fits
e. Shrink fit
f. Types of fits
    1. Loose fit
    2. Free fit
    3. Medium fit
    4. Snug fit
    5. Wringing fit
    6. Tight fit
    7. Heavy force and shrink fit

Provide Demonstration On:

Making the following types of fits:
a. Drive
b. Sliding
c. Running
d. Shrink

Provide Practical Application On:

Make the following types of fits:
a. Drive
b. Sliding
c. Running
d. Shrink

INSTRUCTIONAL MATERIALS

Textbooks:

Burghardt

A/Vs:

Bergwall, Filmstrip #505-6, "Bench Metal Work"

Student Manuals:

a. Ohio, Machine Trades I, Bench Work Assignment Sheet #20
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

Machinery's Handbook

CLASSROOM HOURS

10

EVALUATION (MP-20)

Given necessary tools and equipment, the student will make drive, sliding, running and shrink fits according to correct procedures and safety practices.

TASK

MP-21 Identifying fasteners

PERFORMANCE OBJECTIVE

Identify types of screws, bolts and nuts.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Cut screw thread
b. Rolled screw thread
c. Screw thread inspection methods
d. Types of cuts on machine screws
e. Included angle of the standard V-thread
f. Purpose of an eye bolt
g. Allen set screws
h. Process of rolling a thread
i. Screw thread forms
j. Types of pins
k. Types of T-slot nuts
l. Types of washers
m. Types of screwheads
n. Types of screws
o. Studs

Provide Practical Application On:

Identify various fasteners from a random selection.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

A/Vs:

Prentice-Hall, Filmstrip #XF1128-3, "Working with Nuts and Bolts"

Student Manuals:

a. Ohio, Machine Trades I, Bench Work Assignment Sheet #21
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. American Machinist's Handbook
b. Commercial supply catalog
c. Machinery's Handbook
d. Selection of fasteners

CLASSROOM HOURS

10

EVALUATION (MP-21)

Given a random selection of fasteners, the student will correcly identify each fastener and describe its application.

TASK

MP-22 Using thread, center, fillet and radius gages

PERFORMANCE OBJECTIVE

Use the thread, center, fillet and radius gages for accurate gaging in bench work operations.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Tolerance or allowance on threads
b. Methods of measuring screw threads
c. Wire methods of gaging threads
d. Screw thread micrometer
e. Types of threads
f. Fillet gage
g. Radius gage

Provide Demonstration On:

a. Using a screw thread micrometer
b. Using a fillet gage
c. Using a radius gage
d. Choosing a gage

Provide Practical Application On:

Choose a gage for an assigned measurment and gage using either a thread, center, fillet or radius gage as appropriate.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Bergwall, Filmstrip #503, "Measuring Tools Explained"

Student Manuals:

a. Ohio, Machine Trades I, Bench Work Assignment Sheet #22
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Thread gage
b. Fillet gage
c. Center gage
d. Radius gage

(Continued on back)

CLASSROOM HOURS

10

EVALUATION (MP-22)

Given an assigned measurement and appropriate gages, the student will choose the appropriate gage and make a measurement using either a thread, center, fillet or radius gage. The measurement should be in accordance with the instructor's specifications.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

e. American Machinist's Handbook
f. Machinery's Handbook

TASK

MP-23 Identifying lubricants and greases

PERFORMANCE OBJECTIVE

Identify lubricants and greases used for machine maintenance.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Grease
b. Greasing devices
c. Lubricants used for vertically mounted motor
d. Lubricants used for horizontal motors
e. Viscosity
f. Bearing overheating factors
g. Lubrication systems
h. Drip and wick feeds

Provide Demonstration On:

Choosing a lubricant for a application

Provide Practical Application On:

Choose the appropriate lubricant for a given application.

INSTRUCTIONAL MATERIALS

Textbooks:

Machinery's Handbook

A/Vs:

Bergwall, Filmstrip #501, "The Lathe Explained"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #23

Tools and Equipment:

Commercial supplier's catalogs

CLASSROOM HOURS

5

EVALUATION (MP-23)

Given specifications for a machine which requires lubrication and a lubricant supplier's catalog, the student will choose the appropriate lubricant and method of lubrication.

TASK

MP-24 Performing machine maintenance

PERFORMANCE OBJECTIVE

Perform general shop repairs to maintain shop equipment.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Responsibility for repairs in shop
b. Troubleshooting procedures
c. Using manufacturer's service manual
d. Safety in machine maintenance

Provide Demonstration On:

Troubleshooting shop machinery

Provide Practical Application On:

Troubleshoot a machine which is down and diagnose the problem.

INSTRUCTIONAL MATERIALS

Textbooks:

Specific manufacturer's service manuals

A/Vs:

Prentice-Hall Media, Filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #24

CLASSROOM HOURS

5

EVALUATION (MP-24)

Given a machine which requires service and a manufacturer's service manual, the student will troubleshoot and diagnose the problem and identify the correct repair procedures.

TASK

MP-25 Identifying bench work safety

PERFORMANCE OBJECTIVE

Identify hazards and safety precautions in working with hand tools and portable power tools in the machine shop.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Eye protection
b. Foot protection
c. Ear protection
d. Dust and hazardous fumes
e. Clothing, hair and jewelry
f. Hand protection
g. Lifting

Provide Demonstration On:

Identifying safety hazards in the shop

Provide Practical Application On:

Identify safety hazards in the shop and recommend solutions.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Porter
c. Kibbe

A/Vs:

Bergwall, Filmstrip series #514, "Metal Shop Safety"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #25

Tools and Equipment:

Safety goggles

CLASSROOM HOURS

5

EVALUATION (MP-25)

Given safety hazards in the shop, the student will identify the hazards and recommend safe solutions.

TASK

MP-26 Identifying parts and functions of the drilling machine

PERFORMANCE OBJECTIVE

Identify the parts of a drilling machine and describe their operations.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Parts of the upright drill press
b. Purpose of the parts
c. Functions of the drill
d. Safety

Provide Demonstration On:

Operating a drill press

Provide Practical Application On:

Identify the parts of the drill press and explain what each part does.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Prentice-Hall, Filmstrip #929-1, "Machine Shop: Drill Press"

Student Manuals:

Ohio, Machine Trades I, Drilling Machine Work Assignment Sheet #1

Tools and Equipment:

Upright drill press

CLASSROOM HOURS 5

EVALUATION (MP-26)

Given an upright drill press, the student will accurately identify each part and describe its function.

TASK

MP-27 Identifying safety practices and precautions when using the drilling machine

PERFORMANCE OBJECTIVE

Identify safety practices and precautions on a drilling machine.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Using clamps
b. Broken bits
c. Turning workpiece due to "grabbing" drill bit
d. Keeping drill press table clean of tools
e. Lifting heavy pieces
f. Removing chuck key
g. Hand safety
h. Eye safety
i. Head safety

Provide Practical Application On:

Demonstrate safe drilling machine practice by choosing appropriate safety gear and demonstrate safe working practices.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Porter
c. Kibbe

A/Vs:

Prentice-Hall, Filmstrip #929-1, "Machine Shop: Drill Press"

Student Manuals:

Ohio, Machine Trades I, Drilling Machine Work Assignment Sheet #2

Tools and Equipment:

a. Safety goggles or face shield
b. Safety hat

CLASSROOM HOURS

5

EVALUATION (MP-27)

✓

Given a drilling machine and appropriate safety gear, the student will demonstrate correct safety precautions by choosing the appropriate safety gear and demonstrating safe operating pratices.

TASK

MP-28 Identifying work holding devices and set ups

PERFORMANCE OBJECTIVE

Identify work holding and locating devices used on drilling machines.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of work holding devices
b. Methods
    1. T-bolts and clamps
    2. Parallels
    3. C-clamps
    4. Angle plates
    5. Drill press vises
    6. Cold finished key stock
    7. Vee-blocks
c. Safety

Provide Demonstration On:

Using T-bolts and clamps to hold work down on the drill press

Provide Practical Application On:

a. Use T-bolts and clamps to hold work on the drill press.
b. Identify various types of drill press work holding devices.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Prentice-Hall, Filmstrip #929-1, "Machine Shop: Drill Press"

Student Manuals:

Ohio, Machine Trades I, Drilling Machine Work Assignment Sheet #3

Tools and Equipment:

a. T-bolts
b. Clamps
c. Parallels
d. C-clamps
e. Angle plates
f. Drill press vises
g. Vee-blocks

CLASSROOM HOURS

10

EVALUATION (MP-28)

Given a selection of drill press work holding devices, the student will accurately identify each device and will locate and bolt down a workpiece on the press using T-bolts and clamps.

TASK

MP-29 Identifying and using drill bit holding devices

PERFORMANCE OBJECTIVE

Identify and use drill bit holding devices on the drilling machine.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Drill chuck
b. Shank
c. Tang on tapered shanks
d. Drift or key
e. Drill bit holding devices
f. Safety

Provide Demonstration On:

Mounting a drill bit on the drilling machine

Provide Practical Application On:

Mount a drill bit on the drilling machine.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Prentice-Hall, Filmstrip #929-2, "Machine Shop: Drill Press"

Student Manuals:

Ohio, Machine Trades I, Drilling Machine Work Assignment Sheet #4

Tools and Equipment:

a. Drill bit
b. Drilling machine
c. Chuck

CLASSROOM HOURS 10

EVALUATION (MP-29)

a. Given a drilling machine, drill bit and chuck, the student will accurately follow procedures to mount and drill bit on the drilling machine. The student will observe all safety precautions.

b. V'TECS, Machine Shop, Task No. 62.

TASK

MP-30 Identifying drill bits

PERFORMANCE OBJECTIVE

Identify types, sizes and nomenclature of drill bits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Four parts of a twist drill bit
b. Types of shanks
c. Purpose of flutes
d. Sizes of twist drills
e. Checking a drill for correct size
f. Using an oil hole drill
g. Lip angle
h. Purpose of tang
i. RPM, FPM

Provide Demonstration On:

Checking a drill for correct size for a given job

Provide Practical Application On:

Check a drill for correct size for a given job.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

Student Manuals:

Ohio, Machine Trades I, Drilling Machine Work Assignment Sheet #5

Tools and Equipment:

a. Twist drill bits
b. Drill gage
c. Cleveland Twist Drill Company, Use and Care of the Twist Drill

CLASSROOM HOURS

5

EVALUATION (MP-30)

Given specifications for a job, a drill gage and a selection of twist drill bits, the student will select the correct size twist drill for the job.

TASK

MP-31 Identifying cutting feeds and speeds

PERFORMANCE OBJECTIVE

Identify drill feeds and speeds.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of steel used for twist drills
b. Identifying the high speed drill
c. Setting the speed on a high speed drill 4 x cutting speed ÷ drill diameter
d. The feed of a drill
e. FPM
f. RPM

Provide Demonstration On:

a. Figuring the cutting speed of a given drill
b. Figuring feed

Provide Practical Application On:

a. Figure the cutting speed of a given drill.
b. Figure feed.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

Student Manuals:

Ohio, Machine Trades I, Drilling Machine Work Assignment Sheet #6

Tools and Equipment:

a. Drill bits
b. Drilling machine
c. Assigned job
d. Cleveland Twist Drill Company, Use and Care of the Twist Drill

CLASSROOM HOURS

5

EVALUATION (MP-31)

a. Given all appropriate tools, supplies and equipment, the student will accurately calculate the feed (in FPM) and speed (in RPM) of a high speed twist drill for a specific job.

b. V'TECS, Machine Shop, Task No. 64.

TASK

MP-32 Identifying lathe safety

PERFORMANCE OBJECTIVE

Identify safe practices and precautions for engine lathe work.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Importance of safety
b. Hazards
    1. Long sleeves
    2. Rings, watches, etc.
    3. Files without handles
    4. Pinch points
    5. High temperature components
    6. Sharp edges
c. Safety practices
d. Personal protection gear
e. Housekeeping

Provide Demonstration On:

Proper filing technique in the lathe

Provide Practical Application On:

List six hazards in lathe operation and how to avoid them.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Porter
c. Kibbe

A/Vs:

Bergwall, Filmstrip #514, "Metal Shop Safety"

Student Manuals:

Ohio, *Machine Trades I*, Engine Lathe Work Assignment Sheet #1

CLASSROOM HOURS 5

EVALUATION (MP-32)

Given an overview of lathe safety practices, the student will list at least six safety hazards in lathe operation.

TASK

MP-33 Identifying lathes

PERFORMANCE OBJECTIVE

Identify engine lathe types and sizes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Brief history of automation in industry
b. The lathe
    1. Determining engine size
    2. Three basic types
    3. Purpose of various sizes
    4. Purpose of head-stock
    5. Standard VS quick change geared
    6. "Live center" VS "dead center"
    7. Operations which can be performed on a lathe
    8. Gages and how they are used

Provide Practical Application On:

a. Identify and describe the purpose of the parts of a lathe on a diagram.
b. List the operations which can be performed on a lathe.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, Filmstrip #501-1, "The Lathe Explained"
b. Prentice-Hall Media, Filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #1

Tools and Equipment:

Diagram of a lathe

CLASSROOM HOURS 5

EVALUATION (MP-33)

Given a diagram of a lathe, the student will identify each part or control, accurately describe its use and list at least five operations which can be performed on a lathe.

TASK

MP-34 Identifying work-holding devices

PERFORMANCE OBJECTIVE

Identify work-holding devices as used on a lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Lathe spindle nose
b. Chucks
c. Drive plates
d. Face plates
e. Collets
f. Centering accuracy of various chucks

Provide Practical Application On:

Identify several types of chucks in the lab.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, Filmstrip #501-2, "The Lathe Explained"
b. Prentice-Hall Media, Filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

Ohio, *Machine Trades I*, Engine Lathe Work Assignment Sheet #3

Tools and Equipment:

Several types of chucks

CLASSROOM HOURS

10

EVALUATION (MP-34)

a. Given a selection of lathe workholding devices, the student will identify each type of chuck and describe its relative accuracy.

b. V'TECS, Machine Shop, Task No. 110.

TASK

MP-35 Identifying cutting tools

PERFORMANCE OBJECTIVE

Identify cutting tools and tool holding devices on the lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Cutting tools
b. Geometric form of lathe tools
c. Tool grinding
d. Tool holder
e. Tool holder with back rake
f. Cutting angles
g. Chip safety (chip breakers)
h. Heat hazards

Provide Demonstration On:

a. Grinding a lathe tool
b. Choosing a tool

Provide Practical Application On:

Choose a tool for a specified job and grind the tool to proper shape and dimensions.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, Filmstrip #501-3, "The Lathe Explained"
b. Prentice-Hall Media, Filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #4 and #5
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Grinding wheel
b. Lathe tools
c. South Bend Lathe Works, How to Run a Lathe

CLASSROOM HOURS

10

EVALUATION (MP-35)

Given specifications for a lathe operation, the student will correctly choose the appropriate tool for the job and follow correct procedures in grinding the tool to proper shape for use on the lathe.

TASK

MP-36 Identifying measuring tools

PERFORMANCE OBJECTIVE

Identify measuring tools used in engine lathe work.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Calipers
b. Micrometer
c. Snap and plug gages
d. Steel rules
e. Depth gages
d. Safety

Provide Demonstration On:

Using the following to make measurements:
a. Calipers
b. Micrometer
c. Snap and plug gages
d. Steel rules
e. Depth gages

Provide Practical Application On:

Use the following instruments to make assigned measurements:
a. Calipers
b. Micrometer
c. Snap and plug gages
d. Steel rules
e. Depth gage

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Porter
c. Kibbe
d. U.S. Navy: Tools and Their Uses

A/Vs:

Bergwall, Filmstrip #503, "Measuring Tools Explained"

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #6
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Calipers (inside and outside)
b. Micrometer
c. Snap and plug gages

(Continued on back)

CLASSROOM HOURS

12

EVALUATION (MP-36)

Given assigned objects to measure, the student will follow correct procedures and use the following tools to make measurements:
a. Calipers
b. Micrometer
c. Snap and plug gages
d. Steel ruler
e. Depth gages

INSTRUCTIONAL MATERIALS

Tools and Equipment:

d. Steel rules
e. Depth gage
f. South Bend Lathe Works,
   How to Run a Lathe

TASK

MP-37 Identifying lathe attachments

PERFORMANCE OBJECTIVE

Identify attachments used on an engine lathe and describe their uses.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Center rest
b. Turning long, slim work
c. Follower rest
d. Taper attachment

Provide Demonstration On:

Mounting the following on a lathe:
a. Center rest
b. Follower rest
c. Taper attachment

Provide Practical Application On:

Identify various types of lathe attachments in the lab and mount the following on the lathe:
a. Center rest
b. Follower rest
c. Taper attachment

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, Filmstrip #501-3, "The Lathe Explained"
b. Prentice-Hall Media, Filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

Ohio, Machine Trades I, Engine Lathe Work, Assignment Sheet #7

Tools and Equipment:

a. Center rest
b. Follower rest
c. Taper attachment
d. Lathe
e. Hand tools
f. South Bend Lathe Works, How to Run a Lathe

CLASSROOM HOURS

10

EVALUATION (MP-37)

Given appropriate tools, supplies and equipment, the student will mount and describe use of the following attachments:

a. Center rest
b. Follower rest
c. Taper attachment

TASK

MP-38 Calculating cutting feeds and speeds on the lathe

PERFORMANCE OBJECTIVE

Calculate cutting feeds and speeds on the lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Cutting speed formula
b. Feed
c. Cutting speed
d. Formula for circumference of a circle
e. Variance in cutting speed
f. Figuring feed

Provide Demonstration On:

a. Figuring cutting speed
b. Figuring feed

Provide Practical Application On:

Figure cutting speed and feed for a specified job.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, Filmstrip #501-2, "The Lathe Explained"
b. Prentice-Hall Media, Filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #8
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Lathe
b. Cutting tool
c. Work piece
d. South Bend Lathe Works, How to Run a Lathe

CLASSROOM HOURS 22

EVALUATION (MP-38)

Given specifications for a job and all necessary tools, supplies and equipment, the student will calculate the necessary feed and speed required to complete the job.

TASK

MP-39 Determining RPM

PERFORMANCE OBJECTIVE

Calculate RPM for a known cutting speed, rim speed or surface speed on an engine lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Formula for figuring RPM of a lathe
b. Calculating the formula given cutting speed, rim speed or surface speed

Provide Demonstration On:

Calculating lathe RPM given cutting speed, rim speed or surface speed

Provide Practical Application On:

Work lathe RPM problems.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, Filmstrip #501-2, "The Lathe Explained"
b. Prentice-Hall Media, Filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Ohio, *Machine Trades I*, Engine Lathe Work Assignment Sheet #9
b. *Machine Shop Training Course*, Vol. I

Tools and Equipment:

South Bend Lathe Works, *How to Run a Lathe*

CLASSROOM HOURS

12

EVALUATION (MP-39)

a. Given a known cutting speed, rim speed or surface speed, the student will accurately calculate lathe RPM.

b. V'TECS, Machine Shop, Task No. 109.

TASK

MP-40 Centering stock

PERFORMANCE OBJECTIVE

Identify principles of centering stock on the engine lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Reason for various sizes of combination center drills
b. Methods of locating center holes
c. Standard angle for center holes
d. Square-facing the work
e. Testing the work for trueness
f. Finding centers of irregularly shaped work

Provide Demonstration On:

a. Centering a piece of work on a lathe
b. Testing for trueness

Provide Practical Application On:

Square and center a piece of work on a lathe.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, Filmstrip #501-2, "The Lathe Explained"
b. Prentice-Hall Media, Filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #10
b. Machine Shop Training Course, Vol I

Tools and Equipment:

a. Lathe
b. Workpiece
c. Test bar and dial indicators
d. Centering tools
e. South Bend Lathe Works, How to Run a Lathe

CLASSROOM HOURS

10

EVALUATION (MP-40)

a. Given a specified job and all necessary tools and equipment, the student will correctly center the stock on the engine lathe and check for accuracy of alignment.

b. V'TECS, Machine Shop, Task No. 85 and 86.

TASK

MP-41 Identifying principles of facing

PERFORMANCE OBJECTIVE

Identify principles of and facing on an engine lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Facing
b. Leaving work longer than finished size
c. Right-cut facing tool
d. Half-center
e. Measuring
    1. Steel rule
    2. Vernier caliper
    3. Large micrometer

Provide Demonstration On:

Facing a workpiece

Provide Practical Application On:

Face a workpiece to specified dimensions.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, Filmstrip #501-4, "The Lathe Explained"
b. Prentice-Hall Media, Filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Ohio, *Machine Trades I*, Engine Lathe Work Assignment Sheet #11
b. *Machine Shop Training Course*, Vol. I

Tools and Equipment:

a. Lathe
b. Cutting tool
c. Workpiece
d. Steel rules
e. South Bend Lathe Works, *How to Run a Lathe*

CLASSROOM HOURS

10

EVALUATION (MP-41)

a. Given necessary tools, equipment and specifications, the student will face a workpiece according to specifications. The student will observe all safety practices.

b. V'TECS, Machine Shop, Task No. 98.

TASK

MP-42 Identifying principles of straight turning and turning to shoulders

PERFORMANCE OBJECTIVE

Identify principles of straight turning and turning to shoulders.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Rough turning
    1. Tolerance
    2. Setting the compound
    3. Tool-holder
    4. Safety
    5. Making a trail cut to true up the piece
    6. Lubricating the tail center

b. Finish turning
    1. Selection of cutting tool
    2. Using the micrometer
    3. Safety

(Continued on back)

Provide Demonstration On:

a. Rough turning a piece
b. Finish turning
c. Turning a shoulder

Provide Practical Application On:

a. Perform straight turning on a piece.
b. Perform shoulder turning on a piece.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, Filmstrip #501-4, "The Lathe Explained"
b. Prentice-Hall Media, Filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #12
b. Machine Shop Training Course, Vol. 1

Tools and Equipment:

a. Lathe
b. Cutting tools
c. Safety goggles
d. Micrometer
e. Fillet or radius gage

CLASSROOM HOURS 15

EVALUATION (MP-42)

a. Given appropriate tools, supplies and materials, the student will perform turning operations on the lathe including straight turning and turning to shoulder.

b. V'TECS, Machine Shop, Task No. 100.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

c. Turning to shoulder
    1. Machining a piece to several different diameters
    2. Square shoulder
    3. Angular shoulder
    4. Filleted shoulder
    5. Undercut shoulder
    6. Using the fillet or radius gage

TASK

MP-43 Identifying thread cutting devices

PERFORMANCE OBJECTIVE

Identify thread cutting devices on the engine lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Procedure for threading on a lathe
b. Setting up the lathe for threading
    1. Setting dials on the compound and cross-feed
    2. Setting apron controls
c. Spindle speeds
d. Cutting the thread
e. Left-hand threads
f. Multiple point tool
g. Picking up a thread

Provide Demonstration On:

a. Setting the lathe for cutting threads
b. Cutting threads

Provide Practical Application On:

Set up the lathe for cutting a specified thread and cut the thread.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, Filmstrip #501-6, "The Lathe Explained"
b. Prentice-Hall Media, Filmstrip #XF928, Machine Shop: Engine Lathe"

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #25
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Lathe
b. Thread cutting tool
c. Safety goggles

CLASSROOM HOURS

15

EVALUATION (MP-43)

Given all necessary tools and equipment, the student will set up and operate the lathe to cut a specified thread to correct dimensions. The student will follow all safety rules.

TASK

MP-44 Identifying the parts of a thread

PERFORMANCE OBJECTIVE

Identify the parts of a thread.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Major diameter of a screw
b. Pitch
c. Root and crest
d. Pitch diameter
e. Thread identification
f. Thread depth
g. Sharp-Vee thread form
h. Unified and American National forms
i. Metric threads forms
j. Tolerance symbols

Provide Demonstration On:

Identifying thread designations

Provide Practical Application On:

a. Show the pitch diameter of a screw on a drawing.
b. Show the depth of a thread on a drawing.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

Student Manuals:

a. Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #26
b. Machine Shop Training Course, Vol. I

CLASSROOM HOURS

10

EVALUATION (MP-44)

Given a drawing of a screw, the student will correctly identify the following dimensions on the screw.

a. Major diameter
b. Pitch
c. Root and crest
d. Pitch diameter
e. Helix angle
f. Thread depth

TASK

MP-45 Identifying American National thread standards

PERFORMANCE OBJECTIVE

Identify American National thread standards.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Brief history of National Screw Thread Commission
b. Advantages of American National thread form
c. Included angle
d. National form thread series
e. Symbols used in specifying American threads standards
f. Coarse and fine threads

Provide Demonstration On:

Designating American National threads

Provide Practical Application On:

Given basic dimensions, designate American National threads.

INSTRUCTIONAL MATERIALS

Textbooks:

Kibbe

Student Manuals:

a. Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #27
b. Machine Shop Training Course, Vol. I

CLASSROOM HOURS	10

EVALUATION (MP-45)

Given basic dimensions, the student will correctly specify American National Thread form designation for the thread.

TASK

MP-46 Computing American National thread forms

PERFORMANCE OBJECTIVE

Compute formulas for American National thread forms.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. American National thread forms
b. Formulas for:
    1. Pitch
    2. Diameter
    3. Major diameter
    4. Minor or root diameter
    5. Root and crest
    6. Single depth
    7. Double depth

Provide Demonstration On:

Computing formulas for:
a. Pitch
b. Diameter
c. Major diameter
d. Minor or root diameters
e. Root and crest flats
f. Single depth
g. Double depth

Provide Practical Application On:

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #28
b. Machine Shop Training Course, Vol. I

CLASSROOM HOURS

10

EVALUATION (MP-46)

Given basic dimensions for American National Form threads, the student will correctly compute the following:
a. Pitch
b. Pitch diameter
c. Major diameter
d. Minor or root diameter
e. Root and crest flats
f. Single depth
g. Double depth

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

Compute formulas for:
a. Pitch
b. Pitch diameter
c. Major diameter
d. Minor or root diameter
e. Root and crest flats
f. Single depth
g. Double depth

TASK

MP-47 Computing sharp V-thread formulas

PERFORMANCE OBJECTIVE

Compute sharp V-thread formulas from an example.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Sharp V-thread
b. Dimensions
    1. Thread angle
    2. Pitch
    3. Depth
    4. Major diameter
    5. Pitch diameter
    6. Minor diameter
    7. Crest
    8. Side
    9. Root
c. Formulas
    1. Thread angle
    2. Pitch
    3. Depth
    4. Minor diameter
    5. Pitch diameter
    6. Major diameter

Provide Demonstration On:

Measuring and computing
a. Thread angle
b. Pitch
c. Depth
d. Minor diameter
e. Pitch diameter
f. Major diameter

Provide Practical Application On:

Measure and compute
a. Thread angle
b. Pitch
c. Depth
d. Minor diameter
e. Pitch diameter
f. Major diameter

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #29
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Sharp V-thread screws
b. Measuring tools

CLASSROOM HOURS 10

EVALUATION (MP-47)

Given a screw which has sharp V-thread dimensions and appropriate measuring tools, the student will accurately compute the following dimensions:

a. Thread angle
b. Pitch
c. Depth
d. Minor diameter
e. Pitch diameter
f. Major diameter

TASK

MP-48 Identifying acme threads

PERFORMANCE OBJECTIVE

Identify acme threads and computing dimensions.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Acme thread
b. Advantages of acme thread form
c. Applications of acme thread
d. Depth vs. pitch
e. Classes
    1. 2G
    2. 3G
    3. 4G
f. Included angle
g. Formulas for pitch, depth and width

Provide Demonstration On:

a. Measuring an acme threaded screw with a wire gauge
b. Figuring pitch, depth and width of an acme thread

Provide Practical Application On:

a. Measure an acme thread with a wire thread gauge.
b. Figure pitch, depth and width of an acme thread.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #30
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

Wire thread gauge

CLASSROOM HOURS

10

EVALUATION (MP-48)

Given a screw or bolt with an acme thread form and appropriate gauges, the student will accurately measure the screw or bolt and identify the pitch, depth and width of the threads.

TASK

MP-49 Identifying square threads

PERFORMANCE OBJECTIVE

Identify and figure dimensions of square threads.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Square threads
    1. Purpose
    2. Applications
b. Depth vs. pitch
c. Flank clearance
d. Clearance on major diameter
e. Figuring thickness
f. Figuring pitch, width and depth

Provide Demonstration On:

Figuring the following dimensions on square thread
a. Pitch
b. Width
c. Depth

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #32
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Bolt with square thread
b. Measuring tools

CLASSROOM HOURS

5

EVALUATION (MP-49)

Given a square threaded bolt and appropriate measuring tools, the student will correctly figure the pitch, width and depth of the square thread.

TASK

MP-50 Identifying classes of fits of screw threads

PERFORMANCE OBJECTIVE

Identify the classes of fits of screw threads.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. General thread fitting requirements
b. Unified National Course (UNC)
c. Unified National Fine (UNF)
d. Unified National Special (UNS)
e. Classes
    1. 1A, 2A, 3A
    2. 1B, 2B, 3B
f. Identifying screw thread designations

Provide Demonstration On:

Identifying screw thread designations

Provide Practical Application On:

Select a specified screw thread bolt and identify its classification and applications.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

Student Manuals:

Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #33

Tools and Equipment:

Selection of various sizes of threaded bolts

CLASSROOM HOURS 10

EVALUATION (MP-50)

Given specifications and a selection of threaded bolts, the student will correctly identify the screw thread classification and identify general applications of the type of screw thread.

TASK

MP-51 Using thread gauges

PERFORMANCE OBJECTIVE

Use thread pitch gauges, center gauges and plug and ring gauges.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Thread pitch gauge
   1. Applications
   2. Reading
b. Center gauges
   1. Procedures for use
   2. Applications
c. Plug and ring thread gauges
   1. Applications
   2. Procedures for use

Provide Demonstration On:

Using the following gauges to gauge threads:
a. Thread pitch gauge
b. Center gauges
c. Plug and ring gauges

Provide Practical Application On:

Use the following gauges to gauge assigned threaded bolts:
a. Thread pitch gauges
b. Center gauge
c. Plug and ring gauges

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, Filmstrip #501-6, "The Lathe Explained"
b. Prentice-Hall Media, Filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #34

Tools and Equipment:

a. Thread pitch gauge
b. Center gauges
c. Plug and ring thread gauge
d. Threaded bolts

CLASSROOM HOURS 5

EVALUATION (MP-51)

Given a series of assigned threaded bolts, the student will use the following gauges to accurately measure the screw threads:
a. Pitch
b. Center gauge
c. Plug and ring thread gauge

TASK

MP-52 Using a thread micrometer

PERFORMANCE OBJECTIVE

Use a thread micrometer to measure sharp V and American National threads.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Thread micrometer
   1. Purpose
   2. Parts
   3. Accuracy
b. Thread comparator
   1. Description
   2. Purpose
c. Using the thread micrometer
   1. Points of measurement
   2. Reading the scales

Provide Demonstration On:

Using a thread micrometer

Provide Practical Application On:

Use a thread micrometer to measure assigned threads.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, Filmstrip #501-6, "The Lathe Explained"
b. Prentice-Hall Media, Filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet, #35
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Thread micrometer
b. Threaded bolts

CLASSROOM HOURS

10

EVALUATION (MP-52)

Given a thread micrometer, the student will accurately measure assigned sizes of threads.

TASK

MP-53 Identifying turret lathes

PERFORMANCE OBJECTIVE

Identify types, sizes, specifications and nomenclature of turret lathes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Turret lathes
   1. Advantages
   2. Disadvantages

b. Types of turret lathes

c. Special features of the turret lathe
   1. Trip feed
   2. Stop screws

d. Operations which can be performed on the turret lathe

e. Vertical and horizontal types

f. Parts of the turret lathe

Provide Demonstration On:

Identifying and describing parts of the turret lathe

Provide Practical Application On:

Identify a turret lathe as to type and classification and identify the parts and their functions.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I

b. Kibbe

Student Manuals:

Ohio, *Machine Trades I*, Turret Lathe Work Assignment Sheet #1

Tools and Equipment:

a. Turret lathe

b. The Warner and Swasey Co., *How to Get the Most Out of Your Turret Lathe*

c. The Warner and Swasey Co., *Production Handbook for Turret Lathes*

CLASSROOM HOURS

5

EVALUATION (MP-53)

a. Given a turret lathe, the student will correctly identify the type and classification and name and describe the functions of each part.

b. V'TECS, Machine Shop, Task No. 111.

TASK

MP-54 Identifying turret lathe safety practices

PERFORMANCE OBJECTIVE

Identify hazards of operating the turret lathe and related safety precautions.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Machine speed
b. Chip guards
c. Personal safety devices, clothing
d. Safe operating procedures for the turret lathe
e. Starting and stopping the machine

Provide Demonstration On:

Identifying safety hazards on the turret lathe

Provide Practical Application On:

Identify safety hazards on the turret lathe and recommend solutions.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

Student Manuals:

Ohio, Machine Trades I, Turret Lathe Work Assignment Sheet #2

Tools and Equipment:

Turret lathe

CLASSROOM HOURS

5

EVALUATION (MP-54)

Given a turret lathe, the student will correctly identify safety hazards on the lathe and identify safety precautions related to these hazards.

TASK

MP-55 Maintaining the turret lathe

PERFORMANCE OBJECTIVE

Perform maintenance tasks for proper care of the turret lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Cleaning the machine
b. Lubricating the machine
c. Leveling the machine
d. Adjusting clutches
e. Adjusting gibs
f. Shop maintenance schedule
g. Safety

Provide Demonstration On:

Machine maintenance
a. Cleaning
b. Lubrication
c. Leveling
d. Clutch adjustment
e. Gib adjustment

Provide Practical Application On:

Machine maintenance
a. Clean the lathe
b. Lubricate the lathe
c. Level the lathe
d. Adjust clutches
e. Adjust gibs

INSTRUCTIONAL MATERIALS

Textbooks:

Manufacturer's service or maintenance manual

Student Manuals:

Ohio, Machine Trades I, Turret Lathe Work Assignment Sheet #3

Tools and Equipment:

a. Wrenches
b. Rags
c. Cleaning solvents
d. Brushes
e. Lubricants and greases

CLASSROOM HOURS 5

EVALUATION (MP-55)

Given a turret lathe, service manual and necessary tools and supplies, the student will perform the following maintenance on the lathe:

a. Cleaning
b. Lubrication
c. Leveling
d. Clutch adjustment
e. Gib adjustment

TASK

MP-56 Identifying workholding devices

PERFORMANCE OBJECTIVE

Identify workholding devices on the turret lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Collet chuck
b. Three-jaw chuck
c. Four-jaw chuck
d. Bar chucks
e. Parallel closing type collet chuck
f. Spring type collets
   1. Push out type
   2. Draw back type
   3. Stationary type
g. Power operated collet chuck
h. Arbors
   1. Expanding bushing
   2. Expanding plug
   3. Threaded arbors

Provide Demonstration On:

Identifying chucks, collets and arbors on the turret lathe

Provide Practical Application On:

Identify type of chucks, collets and arbors used on the turret lathe in the lab.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

Student Manuals:

Ohio, Machine Trades I, Turret Lathe Work Assignment Sheet #4

Tools and Equipment:

a. Collets
b. Chucks
c. Arbors

CLASSROOM HOURS 5

EVALUATION (MP-56)

Given various types of work holding devices on the turret lathe, the student will identify the type of collet, chuck or arbor and describe its function.

TASK

MP-57 Identifying chucking operations on the turret lathe

PERFORMANCE OBJECTIVE

Identify types of chucks and procedures for chucking operations on the turret lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Choosing a holding device for chucking work
b. Purpose of holding devices in chucking
c. Types of chucks
    1. Universal
    2. Independent
    3. Combination
    4. Power operated types
d. Other chucks
    1. Two-jaw box, universal
    2. Revolving jaw chuck
e. Chuck jaws
f. Mounting a chuck
g. Second operation chucks

Provide Demonstration On:

Choosing and mounting a chuck

Provide Practical Application On:

Choose an appropriate chuck and mount it on the turret lathe for a specified job.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

Student Manuals:

Ohio, Machinist Trades I, Turret Lathe Work Assignment Sheet #5

Tools and Equipment:

a. Chucks
b. Hand tools

CLASSROOM HOURS 10

EVALUATION (MP-57)

Given a turret lathe an an assigned job, the student will choose the correct chuck for the job and mount the chuck according to correct procedures.

TASK

MP-58 Selecting cutting speed and feed on the turret lathe

PERFORMANCE OBJECTIVE

Select cutting speed and feed for an assigned job on the turret lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Factors which affect speed and feed
b. Setting exact speed and feed (test)
c. Type of finish required
d. Quantity of parts to make VS. speed

Provide Demonstration On:

Determining speeds and feeds on the turret lathe

Provide Practical Application On:

Set the turret lathe speeds and feeds for an assigned job.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

Student Manuals:

Ohio, Machine Trades I, Turret Lathe Work Assignment Sheet #9

Tools and Equipment:

a. Turret lathe
b. Work piece

CLASSROOM HOURS 5

EVALUATION (MP-58)

Given an assigned job on the turret lathe and necessary equipment, tools and materials, the student will correctly set the speed and feed of the machine for the given material. The instructor will evaluate the student's settings.

TASK

MP-59 Identifying coolants and cutting compounds

PERFORMANCE OBJECTIVE

Identify coolants and cutting compounds used on turret lathe jobs.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of coolants
b. Coolants and accuracy
c. Procedure for using a coolant
d. Coolants recommended for various materials

Provide Demonstration On:

Choosing a coolant (or cutting compound) for an assigned material

Provide Practical Application On:

Choose an appropriate coolant or cutting compound for an assigned material.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

Student Manuals:

Ohio, Machine Trades I, Turret Lathe Assignment Sheet #10

Tools and Equipment:

a. Manufacturer's catalogs
b. Work pieces (various types of material)

CLASSROOM HOURS	5

EVALUATION (MP-59)

Given an assigned material to cut, the student will select an appropriate coolant or cutting compound for the material.

TASK

MP-60 Identifying power cut-off saws

PERFORMANCE OBJECTIVE

Identify power cut-off saws by types, sizes, nomenclature and range of work.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Sizing of a power cut-off
b. Cut of the blade
c. Mounting material in the vise
d. Blade maintenance
e. Safety

Provide Demonstration On:

Determining the size (range) of a power cut-off saw

Provide Practical Application On:

Determine the size of a power cut-off saw and identify its cutting capability and use.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Porter

Student Manuals:

Ohio, Machine Trades I, Power Saw Work Assignment Sheet #1

Tools and Equipment:

Power saws, several different types (or pictures)

CLASSROOM HOURS	5

EVALUATION (MP-60)

Given a power cut-off saw, the student will accurately identify the size and type of saw and describe its cutting action.

TASK

MP-61 Identifying power saw safety

PERFORMANCE OBJECTIVE

Identify safe practices and work habits on the power saw.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Belt and pulley guards
b. Loose clothing
c. Jewelry
d. Hair
e. Cutting short pieces
f. Cutting in an old cut with a new blade
g. Personal safety gear

Provide Demonstration On:

Safe use of the power saw

Provide Practical Application On:

Name at least six safety hazards when using a power saw.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

Student Manuals:

Ohio, Machine Trades, I
Power Saw Work Assignment Sheet #2

CLASSROOM HOURS

5

EVALUATION (MP-61)

Given a power saw, the student will identify and describe at least six safety hazards or precautions when using the saw.

TASK

MP-62 Identifying and using work holding devices on the power cut-off saw

PERFORMANCE OBJECTIVE

Identify types of work holding devices used on the power cut-off saw.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Positioning flat stock in the vise
b. Types and sizes of vises
c. Importance of holding work securely in the vise
d. Cutting more than one piece
e. Angular cutting

Provide Demonstration On:

Positioning workpiece in the vise correctly

Provide Practical Application On:

Position a given workpiece in the vise correctly and identify the type and size of vise.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

Student Manuals:

Ohio, Machine Trades I, Power Saw Work Assignment Sheet #3

Tools and Equipment:

a. Power saw
b. Work holding devices

CLASSROOM HOURS

5

EVALUATION (MP-62)

Given a power cut-off saw and an assigned workpiece, the student will correctly position the workpiece in the vise.

TASK

MP-63 Identifying, selecting, mounting and maintaining saw blades

PERFORMANCE OBJECTIVE

Identify, select, mount and maintain saw blades.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Hack saw blades
b. "All hard" blades
c. "Flexible" blades
d. Saw blade tooth patterns
e. Application of saw blades
f. Blade maintenance

Provide Demonstration On:

Choosing a blade for job

Provide Practical Application On:

Choose the correct type of blade for an assigned job.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter
d. Catalogs for saw blades

Student Manuals:

Ohio, Machine Trades I, Power Saw Work Assignment Sheet #4

Tools and Equipment:

Saw blades

CLASSROOM HOURS 5

EVALUATION (MP-63)

Given an assigned job on the power cut-off saw, the student will select an appropriate saw blade for the job.

TASK

MP-64 Identifying speeds, feeds and coolants for power cut-off saws

PERFORMANCE OBJECTIVE

Identify and calculate speeds, feeds and requirements for coolants for the power cut-off saws.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Coolants
b. Cutting speed (strokes per minute)
c. Cutting feed (feed per minute)
d. Operating a saw without coolant
e. Applying coolant

Provide Demonstration On:

Determining feeds, speeds and coolant requirements for a given job

Provide Practical Application On:

Calculate feed, speed and requirements for a coolant on the power cut-off saw and make a specified cut.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

A/Vs:

Bergwall, Filmstrip #505-2, "Bench Metalwork"

Student Manuals:

Ohio, Machine Trades I, Power Saw Work Assignment Sheet #6

Tools and Equipment:

a. Power saw
b. Workpiece
c. Coolant
d. Manufacturer's speed recommendations for saw

CLASSROOM HOURS 10

EVALUATION (MP-64)

a. Given a power cut-off saw, specifications and necessary tools and materials, the student will calculate the appropriate feed and speed for the job, determine coolant requirements and make a specified cut.

b. V'TECS, Machine shop, Task No. 145.

TASK

MP-65 Using the power cut-off saw for straight and angular sawing

PERFORMANCE OBJECTIVE

Set up and use the power cut-off saw to perform straight and angular sawing operations.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Leaving extra length when cutting off material
b. Dull blades
c. Straight cuts
d. Angle cuts
e. Sawing pipe or tube
f. When to change blades
g. Safety

Provide Demonstration On:

Cutting straight and angular cuts on the power hack saw

Provide Practical Application On:

Make an assigned straight or angular cut on the power hack saw.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

A/Vs:

Bergwall, Filmstrip #505-2, "Bench Metalwork"

Student Manuals:

Ohio, Machine Trades I, Power Saw Work Assignment Sheet #6

Tools and Equipment:

a. Power hack saw
b. Blades
c. Work stock
d. Safety goggles

CLASSROOM HOURS

5

EVALUATION (MP-65)

a. Given a power hacksaw, specifications, necessary tools and materials and an assigned workpiece, the student will cut the workpiece to specified dimensions. The student will observe all safety practices.

b. V'TECS, Machine Shop, Task No. 144.

TASK

MP-66 Identifying types, sizes, construction, specifications, nomenclature and range of work for shapers

PERFORMANCE OBJECTIVE

Recognize types and sizes of shapers and what kind of work they do.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Function of the shaper and cuts that can be made
b. Ram motion
c. Determination of size of shaper and type (horizontal or vertical)
d. Ratchet and paw/ mechanism
e. Work table
f. Clapper
g. Apron
h. Power rapid-traverse lever
i. Gib and gib adjustments
j. Coolants and cutting fluids

Provide Demonstration On:

Identifying parts and components of the shaper

Provide Practical Application On:

Identify parts and functions of the shaper.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. McCarthy
d. Kibbe

Student Manuals:

Ohio, Machine Trades II, Shaper Assignment Sheets #2, 13, 14

Tools and Equipment:

a. Shaper
b. Display of work done on a shaper

CLASSROOM HOURS

10

EVALUATION (MP-66)

a. Given a shaper with parts marked or tagged, the student will identify each tagged part and describe the function of each. One hundred percent accuracy is required.

b. Ohio, Machine Trades II, Instructor Manual.

TASK

MP-67 Identifying shaper work holding devices and their functions

PERFORMANCE OBJECTIVE

Identify and describe the functions of work holding devices.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Angle plates
b. Parallels
c. Hold-downs (grippers)
d. Toe dogs
e. Clamps
f. Vises
g. V-blocks
h. T-slots on table
i. Jacks

Provide Demonstration On:

Identifying hold down devices

Provide Practical Application On:

Identify and match work holding devices with specific work requirements.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. McCarthy
d. Kibbe

Student Manuals:

Ohio, Machine Trades II, Shaper Assignment Sheet #3

Tools and Equipment:

a. Shaper
b. Various holding devices

CLASSROOM HOURS

5

EVALUATION (MP-67)

a. Given a shaper and work holding devices, the student will identify each device and describe the type of work the device is used with. One hundred percent accuracy is required.

b. Ohio, Machine Trades II, Instructor Manual.

TASK

MP-68 Identifying shaper cutting tools, grinding them and attaching to machine

PERFORMANCE OBJECTIVE

Identify, grind and attach cutting tools to the shaper.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Left and right hand tools
b. Roughing tools
c. Finishing tools
d. Parting tools (slotting)
e. Dove tail tools
f. Tool holders
g. Clearance angles
h. Cutting angles
i. Rake
j. Tool post and clapper plate

Provide Demonstration On:

a. Selecting a tool and holder for a specific job
b. Grinding or sharpening and installing the tool on the machine

Provide Practical Application On:

a. Make cutter selection
    1. Identify workpiece material.
    2. Determine type of cut (roughing or finishing).
    3. Determine profile of cutter to perform machining operation.
    4. Select proper cutter.

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. McCarthy

Student Manuals:

Ohio, Machine Trades II, Shaper Assignment Sheet #4

Tools and Equipment:

a. Cutting tools
b. Holders
c. Shaper

CLASSROOM HOURS 5

EVALUATION (MP-68)

a. Given a shaper and cutting tools, the student will select a cutting tool for a given job, grind the tool to specifications and install in the correct holder. One hundred percent accuracy is required.

b. Ohio, Machine Trades II, Instructor Manual.

c. V'TECS, Machine Shop, Task No. 155.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

b. Shape and sharpen cutting tool.
    1. Repeat steps 1-3 above.
    2. Select cutter that is appropriate to the job and that fits tool holder.
    3. Check and dress grinding wheel.
    4. Grind tool to rough desired shape (use coolants as necessary).
    5. Measure to determine finish cuts.
    6. Grind tool to desired specifications and sharpen.

TASK

MP-69 Setting up the shaper and calculating speed and feed

PERFORMANCE OBJECTIVE

Set up the shaper and calculate cutting feed and speed.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Speed and feed
b. Strokes per minute (SPM) and feet per minute (FPM)
c. Cutting stroke and return stroke
d. Rough and finish cuts
e. Calculating cutting speed and feed for types of metal, amount to be removed and cutting tool used
f. Rocker arm adjustment
g. Table feed

Provide Demonstration On:

Calculating cutting speed and feed speed and set up the shaper for a given job

Provide Practical Application On:

a. Select and set machine speed.
    1. Identify and classify workpiece material.
    2. Determine desired cutting speed by using formula or table.
    3. By using formula, approximate the machine speed in cutting strokes per minute.

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. McCarthy
d. Kibbe

Student Manuals:

Ohio, Machine Trades II, Shaper Assignment Sheet #5

Tools and Equipment:

a. Shaper
b. Selection of tools and holders
c. Cutting material
d. Machinist's Handbook

CLASSROOM HOURS

10

EVALUATION (MP-69)

a. Given a shaper and necessary tools and equipment, the student will calculate speed and feed for a given job and set the machine up. Calculations must be within ten percent of the instructor's calculations and set up must conform to Machinist Handbook.

b. Ohio, Machine Trades II, Instructor Manual.

c. V'TECS, Machine Shop, Task No. 154.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

    4. Set driving gear or bull wheel to proper machine speed.
b. Select and set for cutting speed.
    1. Identify and classify material of workpiece.
    2. Identify cutter material to be used.
    3. Determine cutting speed by using table specifications.
    4. Determine setting of cutting speed based on desired length of cut and shaper strokes per minute.
    5. Set shaper for desired cutting speed by using operations manual.
c. Select and set feed.
    1. Identify and classify material of workpiece.
    2. Identify cutter material.
    3. Determine cutting speed.
    4. Determine depth of cut needed.
    5. Determine feed according to desired finish.
    6. Set feed according to operations manual.

TASK

MP-70 Adjusting the shaper

PERFORMANCE OBJECTIVE

Set up and adjust the shaper for a specific job.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Stock length and shaper stroke
b. Final checks
c. Position of tool slide
d. Clapper box and tool clearance
e. Position of work in holder
f. Testing for parallelism and squareness
g. Seating work in the vise
h. Paper shimming
i. Aligning the angle plate
j. Adjusting the ram for position and length of stroke
k. Adjusting the table

Provide Demonstration On:

Setting up the shaper for a given job

Provide Practical Application On:

a. Secure holding device.
b. Mount and align key stock.
c. Square workpiece to ram head.
d. Replace key stock with workpiece.
e. Adjust shaper and cutter to workpiece.
    1. Adjust clapper box.
    2. Adjust for clearance.
    3. Adjust for length of stroke.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. McCarthy
d. Kibbe

Student Manuals:

Ohio, Machine Trades II, Shaper Assignment Sheet #6

Tools and Equipment:

a. Shaper
b. Tools and holders
c. Measuring tools
d. Machinist's Handbook

CLASSROOM HOURS 5

EVALUATION (MP-70)

a. Given a shaper and necessary tools and equipment to perform a given job, the student will set up the shaper and align shaper attachments, workpiece and cutter. The cutting tool heel and side clearance must be within 4°. The ram stroke must clear workpiece on forward stroke by ⅛" and ½" on return stroke.

b. Ohio, Machine Trades II, Instructor Manual.

c. V'TECS, Machine Shop, Task No. 153.

TASK

MP-71 Performing a horizontal shaping operation

PERFORMANCE OBJECTIVE

Make a rough and a finish horizontal cut.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Selecting cutting tool
b. Placing stock and adjusting parallels
c. Adjusting rough cut
d. Adjusting finish cut
e. Importance of maintaining free clapper
f. Clapper box angle in relation to feed

Provide Demonstration On:

Setting up machine and making a horizontal cut

Provide Practical Application On:

Set up the machine and make a rough and a finished horizontal cut.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. McCarthy
d. Kibbe

Student Manuals:

Ohio, Machine Trades II, Shaper Assignment Sheet #7

Tools and Equipment:

a. Shaper
b. Cutting stock
c. Tools and holders
d. Measuring tools
e. Machinist's Handbook

CLASSROOM HOURS 10

EVALUATION (MP-71)

a. Given a shaper and necessary tools and equipment, the student will set up the machine and make a horizontal cut to given dimensions. Work must be within tolerances specified by the instructor.

b. Ohio, Machine Trades II, Instructor Manual.

TASK

MP-72 Performing a vertical shaping operation

PERFORMANCE OBJECTIVE

Make a rough and a finished vertical cut.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Selection of cutting tool
b. Positioning the apron, stock and clapper box
c. Operations requiring vertical cuts
d. Automatic and hand feeding
e. Difference between horizontal and vertical cuts
f. Adjusting for rough and finish cuts

Provide Demonstration On:

Setting up machine and making a vertical cut

Provide Practical Application On:

Set up machine and make a rough and a finish vertical cut.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. McCarthy
d. Kibbe

Student Manuals:

Ohio, Machine Trades II, Shaper Assignment Sheet #8

Tools and Equipment:

a. Shaper
b. Cutting stock
c. Tools and holders
d. Measuring tools
e. Machinist's Handbook

CLASSROOM HOURS 10

EVALUATION (MP-72)

a. Given a shaper and necessary tools and equipment, the student will set up the machine and make a veritcal cut according to given dimensions.

b. Ohio, Machine Trades II, Instructor Manual.

TASK

MP-73 Identifying types, sizes, construction, specifications, nomenclature and range of work for planers

PERFORMANCE OBJECTIVE

Recognize types and sizes of planers and what kind of work they do.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Comparison of planer to shapers
b. Types of planers
c. Sizes of planers
d. Types of work done on planers
e. The platen
f. Platen drive
   1. Rack and gear
   2. Helical gear
   3. Hydraulic system
g. Feed rod tool
h. Crossrail
i. Tripping dogs
j. Size and number of tool heads

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. Kibbe

Student Manuals:

Ohio, Machine Trades II, Planer Work Assignment Sheet #1

Tools and Equipment:

a. Planer
b. Display of work done on a planer

CLASSROOM HOURS

10

EVALUATION (MP-73)

a. Given a planer with parts tagged, the student will identify each part and describe the functions and its counterparts on a shaper. One hundred percent accuracy is required.

b. Ohio, Machine Trades II, Instructor Manual.

TASK

MP-74 Identifying and using work holding and clamping devices

PERFORMANCE OBJECTIVE

Select the correct holding device for a specific job.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Bolts
b. Clamps
c. Blocks
d. Jacks
e. Braces
f. Poppets
g. Stops
h. Toe dogs
i. V blocks
j. Angle plates

Provide Demonstration On:

Mounting stock on planer

Provide Practical Application On:

Mounting stock on planer.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. McCarthy
d. Kibbe

Student Manuals:

Ohio, Machine Trades II, Planer Work Assignment Sheet #4

Tools and Equipment:

a. Planer
b. Work holding devices
c. Stock
d. Machninst's Handbook

CLASSROOM HOURS

5

EVALUATION (MP-74)

a. Given a planer and work holding devices, the student will identify and select a device for a given project. The stock must be mounted on the planer according to the Machinist's Handbook.

b. Ohio, Machine Trades II, Instructor Manual.

TASK

MP-75 Identifying planer cutting tools, grinding them and attaching to machine

PERFORMANCE OBJECTIVE

Identify, grind and attach cutting tools to the planer.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Right hand round nose roughing tool
b. Left hand round nose roughing tool
c. Square nose roughing tool
d. Square nose finishing tool
e. Gooseneck finishing tool
f. Right hand dovetail roughing tool
g. Left hand dovetail finishing tool
h. Gang tools
i. Carbide tools
j. Negative rake

Provide Demonstration On:

Grinding and attaching tools

Provide Practical Application On:

Grind and attach tools for specific jobs.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. McCarthy
d. Kibbe

Student Manuals:

Ohio, Machine Trades II, Planer Work Assignment Sheet #4

Tools and Equipment:

a. Planer
b. Cutting tools
c. Machinist's Handbook

CLASSROOM HOURS

10

EVALUATION (MP-75)

a. Given a shaper, cutting tools and a project blueprint, the student will select a cutting tool, grind the tool to specifications and install in the correct tool holder. One hundred percent accuracy is required.

b. Ohio, Machine Trades II, Instructor Manual.

TASK

MP-76 Setting up the planer and calculating speed and feed

PERFORMANCE OBJECTIVE

Set up the planer and calculate cutting and feed speed.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Speed and feed
b. Strokes per minute (SPM) and feet per minute (FPM)
c. Cutting stroke and return stroke
d. Rough and finish cuts
e. Calculating cutting speed and feed for types of metal, amount to be removed and cutting tool used.
f. Table feed

Provide Demonstration On:

Calculating cutting speed and feed speed and setting up the planer for a given job.

Provide Practical Application On:

Calculate cutting and feed speeds and set up the planer for a given job.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. McCarthy
d. Kibbe

Student Manuals:

Ohio, Machine Trades II, Planer Work Assignment Sheet #6

Tools and Equipment:

a. Planer
b. Selection of tools and holders
c. Stock
d. Machinist's Handbook

CLASSROOM HOURS

5

EVALUATION (MP-76)

a. Given a planer and necessary tools and equipment, the student will calculate speed and feed for a given job and set the machine up. Calculations must be within 10% accuracy and set up must conform to the Machinist's Handbook.

b. Ohio, Machine Trades II, Instructor Manual.

TASK

MP-77 Performing planning operations

PERFORMANCE OBJECTIVE

Set up the planer and make a rough and a finish cut on a specified job.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Checking the crossrail for perfect alignment
b. Blocking and shimming
c. The planer gage
d. Regulating table travel
e. Squaring the head
f. Operating at maximum feed and speed
g. Beveling workpiece before starting operation
h. Taking up back lash

Provide Demonstration On:

Setting up and cutting stock

Provide Practical Application On:

a. Set up planer.
b. Select and grind tools.
c. Mount stock.
d. Make a rough and a finish cut.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. McCarthy
d. Kibbe

Student Manuals:

Ohio, Machine Trades II, Planer Work Assignment Sheet #7

Tools and Equipment:

a. Planer
b. Tools and equipment
c. Measuring tools
d. Stock

CLASSROOM HOURS

10

EVALUATION (MP-77)

a. Given a planer and necessary tools and equipment, the student will set up the machine, grind the necessary cutting tools and cut to given dimensions. Work must be done within tolerances specified by the instructor.

b. Ohio, Machine Trades II, Instructor Manual.

TASK

MP-78 Maintaining and caring for the planer

PERFORMANCE OBJECTIVE

Provide daily lubrication, major oil change and other necessary adjustments.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Cleaning the planer
b. Lubricating
c. Oil change
d. Adjustments
e. Inspection

Provide Demonstration On:

Daily maintenance and adjustments

Provide Practical Application On:

Clean and care for the planer as it is used.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. Kibbe

Student Manuals:

Ohio, Machine Trades II, Planer Work Assignment Sheet #15

Tools and Equipment:

a. Manufacturer's lubrication chart
b. Hand tools and equipment for changing oil and adjusting
c. Brush

CLASSROOM HOURS 5

EVALUATION (MP-78)

a. Given a planer, the student will clean, lubricate and adjust according to the manufacturer's specifications.

b. Ohio, Machine Trades II, Instructor Manual.

TASK

MP-79 Identifying types, sizes, construction, specifications, nomenclature and range of work for milling machines.

PERFORMANCE OBJECTIVE

Recognize types and sizes of milling machines and what kinds of work they do.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Functions of the milling machine
b. Column and knee type
c. Adjustable spindle type
d. Plain and universal machines
e. Vertical and bed
f. End and face milling
g. Column
h. Knee
i. Table
j. Spindle
k. Overarm
l. Coolants and cutting fluids

Provide Demonstration On:

Identifying parts and components on the machine

Provide Practical Application On:

Identify parts and functions of the milling machine.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. McCarthy
d. Kibbe

Student Manuals:

Ohio, Machine Trades II, Milling Assignment Sheets #1, 8

Tools and Equipment:

a. Milling machine
b. Display of work done on a milling machine

CLASSROOM HOURS 10

EVALUATION (MP-79)

a. Given a milling machine with parts marked or tagged, the student will identify each tagged part and describe the function of each. One hundred percent accuracy is required.

b. Ohio, Machine Trades II, Instructor Manual.

TASK

MP-80 Identifying milling machine work holding devices and their functions

PERFORMANCE OBJECTIVE

Identify and select a work holding device for a specific job.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Milling machine safety
b. Vises
    1. Flanged
    2. Plain
    3. Cam-action
    4. Swivel
    5. Toolmaker's vise
c. Fixtures
e. Importance of holding workpiece securely and accurately

Provide Demonstration On:

Selecting a work holding device for a given job

Provide Practical Application On:

a. Clean and place vise on bed.
b. Align vise by sight.
c. Fasten vise to bed with clamping bolts.
d. Place dial indicator attachment in mill spindle or magnetic tool holder.
e. Fasten dial indicator to attachment.
f. Indicate the fixed vise jaw.
g. Secure clamp bolts.
h. Re-check with indicator.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. Walker
d. Kibbe

A/Vs:

a. Bergwall, Filmstrip #502-2 "Milling Machine Explained"
b. Prentice-Hall, Filmstrip #VD919-2, "Machine Shop: Horizontal Milling Machine"; #VD920-1, "Machine Shop: Vertical Milling Machine"

Student Manuals:

Ohio, Machine Trades II, Milling Assignment Sheet #14

Tools and Equipment:

a. Milling machine
b. Selection of work holding devices
c. Stock
d. Measuring tools

CLASSROOM HOURS

5

EVALUATION (MP-80)

a. Given a milling machine and work holding devices, the student will identify each device and describe the type of work the device is used with. One hundred percent accuracy is required.

b. Ohio, Machine Trades II, Instructor Manual.

c. V'TECS, Machine Shop, Task No. 115.

TASK

MP-81 Identifying, selecting and aligning milling machine attachments.

PERFORMANCE OBJECTIVE

Identify, select and install a milling machine attachment.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Index head
b. Slotting attachment
c. Rotary table
d. High speed attachment
e. Rack milling attachment
f. Universal milling attachment

Provide Demonstration On:

Selecting and installing the attachment

Provide Practical Application On:

a. Replace draw bar with extended draw bar.
b. Drop quill approximately 3 inches and lock.
c. Insert 90 degree attachment driver in quill and tighten draw bar securely, being careful to align key with keyway.

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
~~c. Walker~~
d. Kibbe

A/Vs:

a. Bergwall, Filmstrip #502-3,4,5, "Milling Machine Explained"
b. Prentice-Hall, Filmstrip #VD919-5, "Machine Shop: Horizontal Milling Machine"; #VD920-4 "Machine Shop: Vertical Milling Machine"

Student Manuals:

Ohio, Machine Trades II, Milling Assignment Sheet #5

Tools and Equipment:

a. Milling machine
b. Selection of attachments
c. Measuring tools

CLASSROOM HOURS

5

EVALUATION (MP-81)

a. Given a milling machine and attachments, the student must select, install and align the correct attachment for a given job. The attachment must be aligned to within ± 0.001".

b. Ohio, Machine Trades II, Instructor Manual.

c. V'TECS, Machine Shop, Task No. 116.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

d. Position indicating surface parallel with table movement
e. Snug the two housing clamp bolts.
f. Attach magnetic base with dial indicator.
g. Indicate the 90 degree milling attachment for parallel alignment with table movement.
h. Secure housing clamp bolts.
i. Re-check step g for accuracy.

TASK

MP-82 Selecting and setting up milling machine cutters and holders

PERFORMANCE OBJECTIVE

Identify and attach cutting tools and holders.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Milling cutters
    1. Spiral end mill
    2. Two lip end mill
    3. T-slot
    4. Woodruff key seat
    5. Involute spur-gear
    6. Plain
    7. Side
    8. Staggered tooth
    9. Slitting saw
    10. Angular
b. Arbors or holders
    1. End mill arbor
    2. Fly cutter arbor
    3. Standard arbor
    4. Face mill arbor
    5. Shell mill arbor
    6. Collet and adapter
    7. Standard arbor
c. Removing metal from the teeth of a cutter

Provide Demonstration On:

Selecting and installing a cutter and holder

Provide Practical Application On:

Select and install a cutter and holder for a specific job.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. Walker
d. Kibbe

A/Vs:

a. Bergwall, Filmstrip #502-2, "Milling Machine Explained"
b. Prentice-Hall, Filmstrip #XF919-2, "Machine Shop: Horizontal Milling Machine"

Student Manuals:

Ohio, Machine Trades II, Milling Assignment Sheet #6

Tools and Equipment:

a. Milling machine
b. Cutters and holders
c. Measuring tools
d. Machinist's Handbook

CLASSROOM HOURS

5

EVALUATION (MP-82)

a. Given a milling machine and necessary tools and equipment, the student will select a cutter for a given job and install in the correct holder. Selection and installation must conform to Machinist's Handbook.

b. Ohio, Machine Trades II, Instructor Manual.

TASK

MP-83 Calculating cutting speeds and feeds for milling machine work

PERFORMANCE OBJECTIVE

Calculate cutting speeds and feeds.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Cutting speed
b. Cutting feed
c. Factors determining speed and feed
d. Tempered cutters
e. Carbide cutters
f. High speed steel cutters
g. Cutting speed formula
h. Rough and finish cuts

Provide Demonstration On:

Determining cutting speed and feed for a given job

Provide Practical Application On:

a. Select and set speed.
    1. Identify and classify material to be machined.
    2. Identify cutter to be used.
    3. Determine condition of milling machine.
    4. Determine depth of cut to be made.
    5. Establish material cutting speed.

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. Walker
d. Kibbe

A/Vs:

Prentice-Hall, Filmstrip #VD919-3, "Machine Shop: Horizontal Milling Machine"

Student Materials:

Ohio, Machine Trades II, Milling Assignment Sheet #7

Tools and Equipment:

a. Milling machine
b. Selection of cutters
c. Stock
d. Machinist's Handbook

CLASSROOM HOURS

10

EVALUATION (MP-83)

a. Given a milling machine and work assignment, the student will select, calculate the speed, feed and install the proper cutter and attachment. Selection, calculation and installation must conform to the Machinist Handbook.

b. Ohio, Machine Trades II, Instructor Manual.

c. V'TECS, Machine Shop, Task No. 137.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

6. Determine speed setting for machine by using handbook tables.
7. Set speed according to operation manual.

b. Select and set feed.
   1. Repeat steps 1-4 above.
   2. Determine appropriate feed by using handbook tables.
   3. Set feed according to operation manual.

TASK

MP-84 Performing a plain milling operation

PERFORMANCE OBJECTIVE

Set up and square the sides of a rectangle.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safety
b. Plain milling cutters
    1. Straight tooth
    2. Helical tooth
c. Slab milling
d. Direction cutter teeth revolve
e. Using the dial indicator to square up vise
f. Caution against moving cutter back over finished work
g. Speeds and feeds

Provide Demonstration On:

a. Selecting cutters and holders
b. Setting up machine
c. Squaring up vise
d. Making cuts

Provide Practical Application On:

a. Identify and classify workpiece material.
b. Mount and position vise.
c. Select and mount cutter.
d. Select and set up speed and feed.
e. Mount and align workpiece to cutter.

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. Walker
d. Kibbe

A/Vs:

a. Bergwall, Filmstrip #502-4, "Milling Machine Explained"
b. Prentice-Hall, Filmstrip #VD919-3, "Machine Shop: Horizontal Milling Machine"; #VD920-2, "Machine Shop: Vertical Milling Machine"

Student Manuals:

Ohio, Machine Trades II, Milling Assignment Sheet #9

Tools and Equipment:

a. Milling machine
b. Plain milling cutters and arbors
c. Dial indicator
d. Vise
e. Workpiece

CLASSROOM HOURS

10

EVALUATION (MP-84)

a. Given a milling machine, a selection of cutters and necessary tools and equipment, the student will square up the sides of a rectangle. Finished measurement must be ± 0.001" of given specifications.

b. Ohio, Machine Trades II, Instructor Manual.

c. V'TECS, Machine Shop, Task No. 115, 116, 139.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

f. Make first cut.
g. Turn off machine, rotate workpiece to place finished side against fixed vise jaw, and secure.
h. Make second cut to depth.
i. Measure for accuracy and place workpiece so that second finished surface (steps g and h) is on the bottom of the vise.
j. Make third cut.
k. Turn off machine, measure for accuracy and rotate workpiece.
l. Cut remaining side.
m. Measure for squareness and accuracy.

TASK

MP-85 Identifying types of gears and their functions

PERFORMANCE OBJECTIVE

Select and identify designs and types of gears.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Internal gears
b. Spur gears
c. Worm gears
d. Rack and pinion gears
e. Hypoid gears
f. Bevel gears
g. Herringbone gears
h. Helical gears
i. Planetary sets
j. Gear ratios
k. Materials used in manufacturing

Provide Demonstration On:

Selecting, identifying and describing the functions of gears

Provide Practical Application On:

Locate and identify various gears and gear sets on display or used in machinery.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Kibbe

Student Manuals:

Ohio, Machine Trades II, Gear Assignment Sheet #1

Tools and Equipment:

a. Selection of gears
b. Gearing arrangements

CLASSROOM HOURS 10

EVALUATION (MP-85)

a. Given a selection of gears and gear arrangements, the student will select and identify each gear. The student will describe at least three uses of each gear. This must be done with 80% accuracy.

b. Ohio, Machine Trades II, Instructor Manual.

TASK

MP-86 Identifying gear tooth elements and their symbols

PERFORMANCE OBJECTIVE

Identify gear symbols used in formulas.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Face
b. Flank
c. Pitch circle
d. Root circle
e. Addendum
f. Dedendum
g. Circular pitch
h. Working depth
i. Clearances
j. Chordal thickness
k. Pitch and outside diameters
l. Pressure angle
m. Tooth profile

Provide Demonstration On:

Naming the gear tooth elements

Provide Practical Application On:

Name the gear tooth elements on different gears.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Kibbe

Student Manuals:

Ohio, Machine Trades II, Gear Assignment Sheet #4

Tools and Equipment:

a. Gears
b. Gear drawings
c. Machinist's Handbook

CLASSROOM HOURS 5

EVALUATION (MP-86)

a. Given a gear drawing, the student will label each part using correct symbols. One hundred percent accuracy is required.

b. Ohio, Machine Trades II, Instructor Manual.

TASK

MP-87 Calculating the pitch, diameters, working depth and clearances for machining gears

PERFORMANCE OBJECTIVE

Make all necessary calculations to machine a spur gear to specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Formulas
   1. Pitch diameter
   2. Diametral pitch
   3. Addendum
   4. Dedendum
   5. Outside diameter
   6. Number of teeth
   7. Tooth thickness
   8. Whole depth
   9. Clearance
   10. Center distance
   11. Working depth
   12. Chordal tooth thickness
   13. Chordal addendum
   14. Center distance

b. Pressure angles

Provide Demonstration On:

Determining the dimensions for a given gear with diametral pitch and pressure angle known

Provide Practical Application On:

Determine the dimensions for a given gear with diametral pitch and pressure angle known.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Kibbe

Student Manuals:

Ohio, Machine Trades II, Gear Assignment Sheets #5, 6, 7, 8

Tools and Equipment:

a. Spur gears
b. Drawings
c. Machinist's Handbook

CLASSROOM HOURS 10

EVALUATION (MP-87)

a. Given a spur gear drawing, the student will calculate all dimensions to a tolerance of ± 0.001".

b. Ohio, Machine Trades II, Instructor Manual.

TASK

MP-88 Identifying grinders, grinding wheels and attachments

PERFORMANCE OBJECTIVE

Identify and match grinders and grinding wheels with work to be performed.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safety while using the grinder
b. Grinding principles and practices
c. Grinding wheels
    1. Component elements
    2. Types and sizes
    3. Selection
    4. Handling, storage and inspection
    5. Truing and dressing
d. Speeds and feeds
e. RPM and grinding wheels
f. Coolants and cutting compound
g. Attachments
h. Cylindrical, internal, surface and face grinding
i. Infeed or plinge cut grinding

Provide Demonstration On:

Safety while using grinder

Provide Practical Application On:

Identify grinders and abrasives for different jobs.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Kibbe

A/Vs:

Bergwall, Filmstrip #504-1, "The Grinding Machine"

Student Manuals:

Ohio, Machine Trades II, Grinding Assignment Sheets #1-12

Tools and Equipment:

a. Grinders
b. Wheels
c. Abrasives
d. Safety equipment

CLASSROOM HOURS 5

EVALUATION (MP-88)

a. Given a selection of grinders and work to be done, the student will match the grinder and abrasive to a specific job. This must be done with one hundred percent accuracy.

b. V'TECS, Machine Shop, Task No. 70, 73, 75.

c. Ohio, Machine Trades II, Instructor Manual.

TASK

MP-89 Using the bench grinder

PERFORMANCE OBJECTIVE

Grind and sharpen tool bits, boring tools and drills.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safety
b. Types and sizes
c. Grinding wheels
d. Wire brush wheel
e. Buffing wheel
f. Dressing and truing wheel
g. Spark tests for metal
h. Tool rests and face guards
i. Caution against grinding soft metals (aluminum, brass, etc.)

Provide Demonstration On:

Sharpening and grinding a planer tool and drill bit

Provide Practical Application On:

Grind drill bits, chisels, planner tools, etc.

INSTRUCTIONAL MATERIALS

Textbooks:

Walker

Student Manuals:

Ohio, Machine Trades II, Bench Grinder Assignment Sheets #1-4

Tools and Equipment:

a. Bench or pedestal grinder
b. Safety equipment
c. Items to be sharpened
d. Work blueprint

CLASSROOM HOURS	5

EVALUATION (MP-89)

a. Given a bench grinder and necessary equipment, the student will grind or sharpen a drill bit, cold chisel, planer tool and boring tool to specifications.

b. V'TECS, Machine Shop, Task No. 72, 74, 75, 81.

c. Ohio, Machine Trades II, Instructor Manual.

TASK

MP-90 Identifying materials used in sheet metalwork

PERFORMANCE OBJECTIVE

Identify the various metals, alloys, coated metals and supplies and special properties required of metals used in the sheet metal industry.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Properties of sheet metals
    1. Strength
    2. Ductility
    3. Malleability
    4. Weldability
    5. Hardness
    6. Toughness
    7. Brittleness
    8. Cold-working
b. Types of sheet metal
    1. Metals
    2. Alloys
    3. Coated metals
    4. Supplies

(continued on next page)

Provide Demonstration On:

a. Identifying types of sheet metal
b. Making property tests on various sheet metals
c. Determining gage, weight and size of metals

Provide Practical Application On:

a. Have student compare various sheet metals by making simple property tests and note how metals react to:
    1. Hammering
    2. Bending
    3. Weight
b. Have student visually identify metal samples on display board.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson, Harold V., Technical Metals
b. Feirer, John L., Metalwork

A/Vs:

Bergwall Productions, Inc., Filmstrip #507, "Sheet Metalwork, Introduction and Overview"

Tools and Equipment:

a. Metal samples
    1. Galvanized iron
    2. Tin plate
    3. Galvannealed iron
    4. Zinc
    5. Black iron sheets
    6. Sheet copper
    7. Aluminum
    8. Stainless steel
b. Hammer
c. Thickness gauge calipers
d. Standard gage and weight tables
e. Rules

CLASSROOM HOURS

10

EVALUATION (MP-90)

a. Given various samples of sheet metals, the student will accurately identify each as to type of metal, alloy or coated metal.

b. Given an instructor developed test, the student will accurately relate the special properties required of metals used in the sheet metal industry.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

c. Factors that determine the selection of various metals
    1. Specifications
    2. Availability
    3. Cost
    4. Economical sizes
d. Standard gages, weights and sizes of sheet metal

TASK

MP-91 Developing sheet metal patterns (stretchouts)

PERFORMANCE OBJECTIVE

Develop a straight-line, a parallel-line, a radial-line and a triangulation sheet metal pattern (stretchout).

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of patterns
   1. Straight-line or angular
   2. Parallel-line or cylindrical development
   3. Triangulation or transition
b. Hems
   1. Single
   2. Double
c. Seams
   1. Lap
   2. Grooved
d. Edges (wired)
e. Master patterns or templates
f. Notching and clipping

Provide Demonstration On:

a. Developing a straight-line layout
b. Developing a parallel-line layout
c. Developing a radial-line layout
d. Developing a triangulation layout
e. Making allowances for edges, seams and hems
f. Notching and dipping sheet metal

Provide Practical Application On:

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson, Harold V., Technical Metals
b. Feirer, John L., Metalwork

A/Vs:

a. Bergwall Productions, Inc., Filmstrip #507, "Straight Line Pattern Development"
b. Bergwall Productions, Inc., Filmstrip #507, "Parallel and Radial Line Pattern Development"

Tools and Equipment:

a. Paper
b. Prick punch
c. Scratch awl
d. Pencil
e. Protractor
f. Straight edge
g. Sheet Metal

CLASSROOM HOURS 10

EVALUATION (MP-91)

Using appropriate tools and straight, parallel, radial and triangulation developments, the student will accurately layout a pattern (stretchout) of each and accurately transfer each to sheet metal.

INSTRUCTIONAL MATERIALS

Provide Practical Application On:

a. Have student develop stretchouts using straight, parallel, radial and triangulation layout.
b. Have student transfer pattern to sheet metal.

TASK

MP-92 Cutting sheet metal

PERFORMANCE OBJECTIVE

Cut sheet metal using hand snips and shears.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Hand snips
    1. Straight snips
    2. Double cutting snips
    3. Howk-billed snips
    4. Aviation snips
    5. Circular cutting snips
    6. Heavy duty snips
b. Cutting straight and curved lines
c. Using the hollow punch
d. Portable power shears
e. Rotary and lever slitting shears
f. Squaring shears
    1. Front gage
    2. Back gage

Provide Demonstration On:

a. Cutting sheet metal with hand snips
b. Using the hollow punch
c. Cutting sheet metal using portable power, rotary and lever slitting shears
d. Cutting sheet metal with squaring shears

Provide Practical Application On:

a. Have student use hand snips to cut to a pattern layout.
b. Have student cut sheet metal with squaring shears.

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson, Harold V., Technical Metals
b. Feirer, John L., Metalwork

A/Vs:

a. Prentice-Hall Media, Filmstrip #VD934, "Cutting Sheet Metal"
b. Bergwall Productions, Inc., Filmstrip #507, "Cutting Methods"

Tools and Equipment:

a. Squaring shears
b. Hand snips
c. Metal
d. Pattern
e. Prick punch
f. Scratch awl
g. Hollow punch
h. Ballpeen hammer
i. Cold-chisel
j. Hacksaw
k. Combination square

CLASSROOM HOURS 5

EVALUATION (MP-92)

a. Provided a pattern and metal, the student will accurately cut sheet metal to the pattern using hand snips.

b. Provided a pattern and metal, the student will accurately transfer the pattern and use squaring shears to cut the metal.

INSTRUCTIONAL MATERIALS

Provide Information On:

3. Front and bevel-gage with pattern

g. Cold chisel

TASK

MP-93 Bending sheet metal by hand

PERFORMANCE OBJECTIVE

Bend sheet metal by hand.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Bending equipment
    1. Bench plate or stakeholder
    2. Beakhorn stake
    3. Bottom stake
    4. Coppersmith stake
    5. Common square stake
    6. Beveled-edge stake
    7. Double-seaming stake
    8. Round-head stake
    9. Hatchet stake
    10. Creasing stake
    11. Needle case stake
    12. Candlemold stake
    13. Blowhorn stake
    14. Conductor stake

(Continued on next page)

Provide Demonstration On:

a. Using stakes, seamers, hammers and mallets
b. Making angular bends
c. Bending cylindrical shapes
d. Forming cone-shaped articles

Provide Practical Application On:

a. Have student make a sharp-angle bend over hatchet stake.
b. Have student form a curved piece over a stake or pipe.
c. Have student form a cone-shaped object such as part of a funnel.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson, Harold V., Technical Metals
b. Feirer, John L., Metalwork

A/Vs:

Bergwall Productions, Inc., Filmstrip #507, "Forming and Bending-Part 2"

Tools and Equipment:

a. Stakes
b. C-clamps
c. Vise
d. Hardwood blocks
e. Steel bars
f. Wooden or rawhide mallet
g. Riveting hammer
h. Setting-down hammer
i. Seamers
j. Metal

CLASSROOM HOURS

5

EVALUATION (MP-93)

Using previously cut metal and appropriate bending tools, the student will, by hand, make a box to 1/32" accuracy and form a cylinder and a cone to job specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

    15. Hollow mandrel stake
    16. Double-seaming stake with four heads
    17. Handy seamer
    18. Riveting hammer
    19. Setting-down hammer
    20. Wooden or rawhide mallet
b. Angular bends
c. Bending cylindrical shapes
d. Forming cone-shaped articles

TASK

MP-94 Bending metal on a bar folder or brake

PERFORMANCE OBJECTIVE

Bend metal on a bar folder or brake.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Operation of the bar folder
b. Making a fold or hem
c. Making a rounded fold for a wired edge
d. Brakes
    1. Cornice brake
    2. Box and pan brake

Provide Demonstration On:

a. Operating the bar folder
b. Forming folds and hems on the bar folder
c. Operating brakes

Provide Practical Application On:

a. Have student use the bar folder to form a sharp fold, a rounded fold, right-angle folds, a hem and a double hem.
b. Have student use a box and pan brake to form a box.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson, Harold, V., Technical Metals
b. Feirer, John L., Metalwork

A/Vs:

Bergwall Productions, Inc., Filmstrip #507, "Drilling Forming and Bending-Part 1"

Tools and Equipment:

a. Bar folder
b. Brake
c. Setting hammer
d. Metal
e. Mallet

CLASSROOM HOURS 10

EVALUATION (MP-94)

a. Using sheets of metal and a bar folder, the student will accurately form a sharp fold, a rounded fold, right-angle folds, a hem and a double hem.

b. Using a box and pan brake, the student will accurately make a layout on the metal and form a box.

TASK

MP-95 Roll-forming sheet metal

PERFORMANCE OBJECTIVE

Roll-form sheet metal.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Operation of forming folds or slip-roll forming machines
b. Forming a cylinder
c. Rolling a cylinder with a fold on both edges
d. Rolling a cylinder with a wired edge
e. Forming cone shapes

Provide Demonstration On:

a. Operating the roll-forming machine
b. Forming a cylinder or a cylinder with a fold on both edges
c. Rolling a cylinder with a wired edge
d. Forming cone shapes

Provide Practical Application On:

a. Have student form a cylinder and a cylinder with a fold on both edges.
b. Have student roll a cylinder with a wired edge.
c. Have student roll-form a cone shape.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson, Harold V., Technical Metals
b. Feirer, John L., Metalwork

Tools and Equipment:

a. Metal
b. Roll-forming machine

CLASSROOM HOURS 10

EVALUATION (MP-95)

Using a roll-forming (or slip rolling) machine and sheets of metal, the student will accurately form a cylinder, a cylinder with a fold on both edges, a cylinder with wired edge and a cone.

TASK

MP-96 Making seams

PERFORMANCE OBJECTIVE

Form sheet metal seams.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Seams
   1. Single
   2. Butt
   3. Lap
      (a) Plain lap
      (b) Counter sunk or offset lap
      (c) Inside or outside corner lap
   4. Grooved and folded
   5. Standing
   6. Double
   7. Cap-strip
   8. Pittsburgh lock

b. Hand groovers

Provide Demonstration On:

a. Double-seaming a bottom on a cylinder

b. Double-seaming a square or rectangular article

c. Making a folded or grooved seam

Provide Practical Application On:

a. Have student form single, butt, lap, standing and double seams.

b. Have student form a folded or grooved seam.

INSTRUCTIONAL MATERIALS

Textbooks:

a. John, Harold V., Technical Metals

b. Feirer, John L., Metalwork

A/Vs:

a. Prentice-Hall Media, Filmstrip #VD934, "Seams and Joints"

b. Bergwall Productions, Inc., Filmstrip #507,, "Assembly and Fastening"

Tools and Equipment:

a. Bar folder or brake

b. Burring machine

c. Hand groover

d. Setting hammer

e. Mallet

f. Stakes

g. Metal

CLASSROOM HOURS

5

EVALUATION (MP-96)

a. Given a burring or flanging machine, setting hammer and a cylinder, the student will accurately form single seams to fasten a bottom to the cylinder.

b. Given a bar folder, mallet, setting hammer and metal, the student will accurately form a double seam on a square container.

c. Given a bar folder, metal, a hand groover and mallet, the student will accurately form a folded or grooved seam.

TASK

MP-97 Using the rotary machine

PERFORMANCE OBJECTIVE

Use the rotary machine to wire an edge, turn a burr, bead and crimp sheet metal.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The combination rotary machine
b. Making a wired edge
c. Turning an edge
d. Closing the wired edge by hand
e. Closing the wired edge by machine
f. Turning a burr or flange
g. Beading
    1. The single bead
    2. The ogee bead
    3. The triple bead
h. Crimping
i. Slitting and trimming

Provide Demonstration On:

a. Using the rotary machine
b. Wiring an edge
c. Turning a burr
d. Beading
e. Crimping

Provide Practical Application On:

a. Have student wire an edge.
b. Have student bead, crimp, slit and trim metal.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson, Harold V., Technical Metals
b. Feirer, John L., Metalwork

Tools and Equipment:

a. Combination rotary machine
b. Mild steel wire
c. Stakes
d. Pliers
e. Mallet
f. Setting hammer
g. Metal

CLASSROOM HOURS 5

EVALUATION (MP-97)

a. Using the combination rotary machine, hand tools and wire, the student will select the appropriate tools and accurately wire the edge of a cylinder.

b. Given a cylindrical container, the student will select the appropriate tools to be placed on the combination rotary machine and accurately form a single bead, an ogee bead and a triple bead.

c. Given a cylindrical object, such as a heating pipe, the student will select the appropriate tools to be placed on the combination rotary machine and accurately crimp the edge of one end of the pipe.

TASK

MP-98 Fastening sheet metal

PERFORMANCE OBJECTIVE

Fasten sheet metal with rivets or sheet metal screws.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Riveting tools and rivets
   1. Riveting hammer
   2. Solid punch
   3. Rivet set
   4. Tinner's rivets
      (a) Black-iron
      (b) Galvanized
      (c) Copper
   5. Blind or pop rivets
   6. Hand lever
b. Riveting sheet metal
   1. Determining rivet length
   2. Determining rivet diameter
   3. Spacing rivets
   4. Removing a rivet

(Continued on back)

Provide Demonstration On:

a. Using riveting tools and rivets
b. Riveting sheet metal
c. Fastening sheet metal with tapping screws

Provide Practical Application On:

a. Have student rivet sheet metal.
b. Have student fasten sheet metal with tapping screws.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson, Harold V., Technical Metals
b. Feirer, John L., Metalwork

A/Vs:

a. Bergwall Productions, Inc., Filmstrip #507, "Assembly and Fastening"
b. Prentice-Hall Media, Filmstrip #VD934, "Riveting and Fastening"

(Continued on back)

Tools and Equipment:

a. Rivet set
b. Solid punch
c. Riveting hammer
d. Hand lever
e. End-grain wood or lead block
f. Metal
g. Prick punch
h. Drills
i. Screws
j. Screwdriver

CLASSROOM HOURS 5

EVALUATION (MP-98)

a. Given riveting tools, rivets and a seam to be fastened, the student will accurately select the appropriate tools and set the necessary rivets.

b. Given two pieces of metal to secure together, the student will accurately select the appropriate tools and fasten the metal with threaded fasteners.

INSTRUCTIONAL ACTIVITIES	INSTRUCTIONAL MATERIALS
Provide Information On:	A/Vs:
c. Fastening with tapping screws 1. Thread cutting screws 2. Thread forming screws d. Installing sheet metal screws	c. Prentice-Hall Media, Filmstrip/cassette, "Making Holes in Sheet Metal"

TASK

MP-99 Soft soldering sheet metal

PERFORMANCE OBJECTIVE

Soft solder sheet metal.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Soldering
b. Soldering devices
   1. Soldering coppers
   2. Soldering furnace or blowtorch
   3. Electric soldering iron
   4. Soldering gun
   5. Bunsen burner
   6. Bottled-gas soldering torch
c. Solders (soft)
   1. Bar
   2. Solid wire
   3. Acid or resin-core wire
   4. Soldering paste

(Continued on back)

Provide Demonstration On:

a. Using soldering devices
b. Tinning a soldering copper
c. Soldering a seam or joint
d. Resistance soldering
e. Sweat soldering

Provide Practical Application On:

a. Have student solder a right-angle joint.
b. Have student solder an appendage.
c. Have student tin a soldering copper.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson, Harold V., Technical Metals
b. Feirer, John L., Metalworks

A/Vs:

a. Prentice-Hall Media, Filmstrip #VD934, "Soldering"
b. Bergwall Productions, Inc., Filmstrip #507, "Assembly and Fastening"

Tools and Equipment:

a. Soldering coppers
b. Solders
c. Fluxes
d. Bunsen burner
e. Electric soldering iron
f. Sal ammoniac
g. Cleaning fluid
h. Wire brush
i. File
j. Abrasive cloth
k. Steel wool

CLASSROOM HOURS 5

EVALUATION (MP-99)

a. Given two pieces of metal, cleaning materials, flux, a soldering copper and solder, the student will accurately solder a seam.

b. Given 3 pieces of metal, flux, solder, soldering copper and a bunsen burner, the student will accurately sweat solder the metal.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

d. Fluxes
    1. Corrosive
    2. Non-corrosive
e. Tinning a soldering copper
f. Cleaning sheet metal before soldering
g. Soldering a seam or joint
h. Sweat soldering
i. Resistance soldering
    1. Power unit
    2. Hand piece
    3. Electrodes

TASK

MD-01 Transforming units

PERFORMANCE OBJECTIVE

Convert units from one system to another.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Units of measurement
b. Relationships between systems of measurement

Provide Demonstration On:

Cancelation method of converting units

Provide Practical Application On:

Transforming units

INSTRUCTIONAL MATERIALS

Textbooks:

a. Zebrowski
b. Marcus and Thrower

Tools and Equipment:

a. Calculator
b. Tables of conversion factors

CLASSROOM HOURS

15

EVALUATION (MD-01)

Using a calculator, conversion tables and cancelation methods, the student will convert units from one system of measurement to another without changing the size of the phenomenon.

TASK

MD-02 Calculating resultant force

PERFORMANCE OBJECTIVE

Calculate the force resulting from the combination of two or more forces.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Force as a vector force in static and dynamic systems
b. Calculating components of forces

Provide Demonstration On:

a. Using graphical methods for finding resultant force
b. Using component method for calculating the resultant of forces

Provide Practical Application On:

a. Using graphical methods for finding resultant forces
b. Calculating resultant forces

INSTRUCTIONAL MATERIALS

Textbooks:

a. Zebrowski
b. Marcus and Thrower
c. Levinson

Tools and Equipment:

a. Drafting tools
b. Calculator with trigonometric functions

CLASSROOM HOURS

15

EVALUATION (MD-02)

Using a calculator or drafting equipment, the student will determine the resultant of two or more forces in a plane.

TASK

MD-03 Calculating forces in static systems

PERFORMANCE OBJECTIVE

Calculate unknown forces required to keep the system in equilibrium.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Forces in equilibrium
b. Static structural systems
c. Torques in equilibrium

Provide Demonstration On:

Calculating forces from static systems using graphical, component and parallelagram and torque methods

Provide Practical Application On:

a. Calculating tension or compression in members of structural systems in equilibrium
b. Calculating force required to put systems of forces in equilibrium
c. Calculating forces from torques in equilibrium

INSTRUCTIONAL MATERIALS

Textbooks:

a. Zebrowski
b. Levinson

Tools and Equipment:

a. Calculator
b. Drafting tools

CLASSROOM HOURS 10

EVALUATION (MD-03)

Given a static system of forces in the plane, the student will calculate the direction and magnitude of unknown forces in the system using graphical or mathematical methods.

TASK

MD-04 Calculating stress

PERFORMANCE OBJECTIVE

Calculate the stress in an elastic element under tension or compression.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Calculating areas
b. Elastic limit of materials
c. Factors of safety
d. Ultimate strength of materials

Provide Demonstration On:

Calculating stress given axile load and cross section

Provide Practical Application On:

a. Calculating stress
b. Checking stress with allowable loads to predict suitability of design

INSTRUCTIONAL MATERIALS

Textbooks:

a. Zebrowski
b. Bruch
c. Levinson

Tools and Equipment:

Calculator

CLASSROOM HOURS	15

EVALUATION (MD-04)

Given the geometric configuration of an elastic element under axile load, the student will calculate the stress in the element and predict the suitability of the design using a calculator and properties of materials tables. The calcuation of stress should be accurate.

TASK

MD-05 Calculating strain

PERFORMANCE OBJECTIVE

Calculate the strain in an elastic system under tension or compression.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Relationship between stress and strain
b. Keeping units of length and deformation the same
c. Working with small numbers

Provide Demonstration On:

Calculating strain

Provide Practical Application On:

Calculating strain

INSTRUCTIONAL MATERIALS

Textbooks:

a. Zebrowski
b. Levinson

Tools and Equipment:

Calculator

CLASSROOM HOURS 10

EVALUATION (MD-05)

Given the deformation and length of an elastic element under axile load, the student will calculate, within rounding error, the strain in the element.

TASK

MD-06 Calculating deformation

PERFORMANCE OBJECTIVE

Calculate the deformation of elastic elements under axile loads.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Young's modulus for materials
b. Elastic limit of materials
c. Stress-strain curves

Provide Demonstration On:

Calculating deformation in systems under tension and in systems under compression

Provide Practical Application On:

a. Calculating deformation
b. Designing elements subject to deformation under axile loads

INSTRUCTIONAL MATERIALS

Textbooks:

a. Zebrowski
b. Levinson

Tools and Equipment:

Calculator

CLASSROOM HOURS 10

EVALUATION (MD-06)

Using Young's modulus of materials, the student will calculate, within rounding error, the axile deformation of elastic elements under tension or compression.

TASK

MD-07 Calculating restoring force

PERFORMANCE OBJECTIVE

Calculate the elastic restoring force in an elastic element under axile stress.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Hooke's law
b. Stiffness of springs

Provide Demonstration On:

a. Forces in springs
b. Stretching elastic materials

Provide Practical Application On:

a. Calculating forces in elastic elements under axile loads
b. Calculating stiffness of springs
c. Calculating change in length of springs under axile loads

INSTRUCTIONAL MATERIALS

Textbooks:

a. Zebrowski
b. Levinson

Tools and Equipment:

Calculator

CLASSROOM HOURS	10

EVALUATION (MD-07)

Using Hooke's law and the stiffness of an elastic element, the student will calculate, within rounding error, the restoring force of an elastic element deformed by an axile load.

TASK

MD-08 Designing area of materials under stress

PERFORMANCE OBJECTIVE

Design the cross-sectional area of a mechanical or structural element to function under axile loads.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Calculating areas
b. Elastic limit of materials

Provide Demonstration On:

Designing cross-section under axile loads

Provide Practical Application On:

Designing cross-sectional areas of structural elements to function under axile loads

INSTRUCTIONAL MATERIALS

Textbooks:

a. Zebrowski
b. Levinson

Tools and Equipment:

Calculator

CLASSROOM HOURS

15

EVALUATION (MD-08)

Given properties of materials tables, the student will design the cross-sectional area of a structural element to function under axile loads. The configuration should be calculated within rounding error.

TASK

MD-09 Calculating frictional forces

PERFORMANCE OBJECTIVE

Calculate forces on object subject to friction.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Coefficients of static and kinetic friction for various materials
b. Angle of repose
c. Angle of uniform slip

Provide Demonstration On:

a. Angle of repose
b. Angle of uniform slip
c. Static friction
d. Kinetic friction
d. Calculating frictional force

Provide Practical Application On:

Calculating static and kinetic frictional forces

INSTRUCTIONAL MATERIALS

Textbooks:

a. Zebrowski
b. Marcus and Thrower
c. Pollack
d. Olivo and Wayne

Tools and Equipment:

Calculator

CLASSROOM HOURS

10

EVALUATION (MD-09)

Given coefficients of friction tables, the student will calculate static or kinetic frictional forces between objects of various materials. Calculations should be within rounding error.

TASK

MD-10 Calculating mass

PERFORMANCE OBJECTIVE

Calculate the mass of objects from their weight.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Use of mass
b. Units of mass
c. Newton's laws
d. Newton's law of universal gravitation
e. Acceleration due to gravity

Provide Practical Application On:

Calculating mass in the following systems:

1. Meters-Kilograms-Second (MKS)
2. Foot-Pound-Seconds (FPS)
3. Centimeter-Gram-Second (CGS)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Zebrowski
b. Harris and Hemmerling
c. Pollack
d. Marcus and Thrower

Tools and Equipment:

Calculator

CLASSROOM HOURS

10

EVALUATION (MD-10)

Given the weight of an object, the student will calculate, within rounding error, its mass in the FPS, CGS or MKS systems.

TASK

MD-11 Describing motion on one dimension

PERFORMANCE OBJECTIVE

Describe the motion of an object experiencing translation of position.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Acceleration
b. Velocity
c. Galileo's technique
d. Falling body fomulas

Provide Demonstration On:

a. Finding areas under
    1. Velocity-time
    2. Acceleration-time curves
b. Finding slopes of
    1. Position-time
    2. Velocity-time curves

Provide Practical Application On:

Calculating the parameters of displacement:
1. Distance
2. Time
3. Velocity
4. Acceleration

INSTRUCTIONAL MATERIALS

Textbooks:

a. Zebrowski
b. Harris and Hemmerling
c. Pollack
d. Marcus and Thrower

Tools and Equipment:

a. Calculator
b. Drafting equipment

CLASSROOM HOURS

10

EVALUATION (MD-11)

Using Galileo's technique or time distance, velocity, acceleration formulas, the student will accurately describe the motion of an object or point experiencing a one dimensional change in position.

TASK

MD-12 Describing motion resulting from forces

PERFORMANCE OBJECTIVE

Describe motion resulting from the application of one or more forces.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Units of force
b. Newton's laws
c. Formulas describing motion and forces
d. Coefficients of friction of materials

Provide Demonstration On:

a. Angle of repose
b. Angle of uniform slip

Provide Practical Application On:

Calculating a description of motion from forces given

INSTRUCTIONAL MATERIALS

Textbooks:

a. Zebrowski
b. Harris and Hemmerling
c. Pollack
d. Marcus and Thrower

Tools and Equipment:

Calculator

CLASSROOM HOURS 10

EVALUATION (MD-12)

Using Newton's laws, the student will correctly describe the motion of an object acted on by one or more forces.

TASK

MD-13 Describing motion resulting from torques

PERFORMANCE OBJECTIVE

Describe rotational motion resulting from torques.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Calculating moment of inertia
b. Simularities between linear and rotating systems
c. Units for rotational motion

Provide Demonstration On:

Rotational inertia

Provide Practical Application On:

Describing the motion of rotating objects resulting from torques

INSTRUCTIONAL MATERIALS

Textbooks:

a. Zebrowski
b. Harris and Hemmerling
c. Pollack
d. Marcus and Thrower

Tools and Equipment:

Calculator

CLASSROOM HOURS 10

EVALUATION (MD-13)

Using formulas and torques, the student will calculate, within rounding error, the parameters for describing rotational motion in the required units.

TASK

MD-14 Describing motion using momentum principles

PERFORMANCE OBJECTIVE

Describe motion of objects using the law of conservation of momentum.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The law of conservation of momentum
b. Calculating momentum
c. Momentum as a vector

Provide Demonstration On:

The conservation of momentum

Provide Practical Application On:

Describing motion using the law of conservation of momentum

INSTRUCTIONAL MATERIALS

Textbooks:

a. Zebrowski
b. Harris and Hemmerling
c. Pollack
d. Marcus and Thrower

Tools and Equipment:

a. Calculator
b. Drafting tools

CLASSROOM HOURS 10

EVALUATION (MD-14)

Using the law of conservation of momentum, the student will numerically or graphically describe, within scale or rounding error, the motion (velocity and direction) of a two body event.

TASK

MD-15 Describing motion using energy principles

PERFORMANCE OBJECTIVE

Use conservation of energy to describe the motion of objects.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Calculating:
   1. Kinetic energy
   2. Potential energy

b. The relationship between kinetic and potential energy

c. Nonconservative systems

Provide Demonstration On:

Falling bodies

Provide Practical Application On:

Describing the motion of objects or systems using conservation of energy principles

INSTRUCTIONAL MATERIALS

Textbooks:

a. Zebrowski

b. Harris and Hemmerling

c. Pollack

d. Marcus and Thrower

Tools and Equipment:

Calculator

CLASSROOM HOURS

10

EVALUATION (MD-15)

Using the conservation of energy principle, the student will numerically describe the motion of an object or system acted on by conservative forces.

TASK

MD-16 Calculating work

PERFORMANCE OBJECTIVE

Calculate work as a function of force and distance or change in energy.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The relationship between work and change in energy
b. Work as the area under a force-distance curve
c. The units of work

Provide Demonstration On:

Calculating work mathematically and graphically

Provide Practical Application On:

Calculating work

INSTRUCTIONAL MATERIALS

Textbooks:

a. Zebrowski
b. Harris and Hemmerling
c. Pollack
d. Marcus and Thrower

Tools and Equipment:

a. Calculator
b. Drafting equipment

CLASSROOM HOURS 15

EVALUATION (MD-16)

Using change in energy or the area under a force-distance curve, the student will calculate, within rounding error, the work done by a force in a mechanical system in the proper units.

TASK

MD-17 Calculating power

PERFORMANCE OBJECTIVE

Calculate power as a function of work.

INSTRUCTIONAL ACTIVITIES

Provide Information On:	Provide Demonstration On:
Units of power	Calculating power

Provide Practical Application On:

Calculating power

INSTRUCTIONAL MATERIALS

Textbooks:

a. Zebrowski
b. Harris and Hemmerling
c. Pollack
d. Marcus and Thrower

Tools and Equipment:

Calculator

CLASSROOM HOURS 15

EVALUATION (MD-17)

Using work-time, the student will calculate power in the proper units. The calculation should be numerically correct within rounding error.

TASK

MD-18 Calculating efficiency

PERFORMANCE OBJECTIVE

Calculate the efficiency of a nonconservative mechanical system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Indicated horsepower
b. Friction horsepower
c. Brake horsepower

Provide Demonstration On:

Calculating efficiency

Provide Practical Application On:

a. Calculating efficiency
b. Calculating power requirements as a function of work time and efficiency

INSTRUCTIONAL MATERIALS

Textbooks:

a. Zebrowski
b. Harris and Hemmerling
c. Pollack
d. Marcus and Thrower

Tools and Equipment:

Calculator

CLASSROOM HOURS 15

EVALUATION (MD-18)

Using work input and output or power input and output, the student will calculate, within rounding error, the efficiency of a mechanical system.

TASK

FP-01 Identifying principles of hydraulics

PERFORMANCE OBJECTIVE

Identify principles of hydraulics.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Fluid power systems
   1. Pneumatics
   2. Hydraulics
b. Force
c. Weight
d. Mass
e. Pressure
   1. Atmospheric
   2. Hydraulic
f. Work
g. Power
h. Types of energy used in
   1. Electrical
   2. Hydraulic
   3. Kinetic
   4. Potential energy
   5. Heat energy
i. Incompressible liquids
j. Non-diffusion
k. Hydrostatic pressure
l. Pascal's Law
m. Transmission of fluid power
n. Fluid flow in pipes
   1. Stream line
   2. Turbulent
   3. Cavitation
o. Bernoulli's Principle
p. The effect of heat on liquids
q. Hydraulic power system
   1. Pump
   2. Control valve
   3. Activating unit
   4. Hydraulic fluid
   5. Piping or tubing
r. Modified base hydraulic system

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Howard W. Sams and Co., ABC's of Hydraulic Circuits
c. Pippenger and Hicks, Industrial Hydraulics
d. Delmar, Electromechanical Technology Series, Fluids

A/Vs:

Howard W. Sams and Co., Transparency #20592, "Fluid Power Transparency Masters"

Student Manuals:

a. Plant Engineering Training Systems, Basic Hydraulics, Lesson One
b. Oregon, IM-HY-02, Ils

CLASSROOM HOURS

10

EVALUATION (FP-01)

Given an overview of basic hydraulics principles and terms, the student will identify the principles and describe the components of a basic hydraulic system. The completed task must be rated as acceptable according to the instructor's specifications.

TASK

FP-02 Identifying hydraulic fluids

PERFORMANCE OBJECTIVE

Identify hydraulic fluids.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Functions of hydraulic fluids
b. Physical properties of hydraulic fluids
c. Viscosity
    1. Saybolt Universal Seconds (SUS)
    2. American Society for Testing Materials (ASTM)
    3. Viscosity and pressure
d. Pour point
e. Fluid selection
f. Effects of too low/too high fluid levels
g. Component protection
h. Chemical properties
i. System contamination
i. System contamination
    1. Water - demulsification, vapor pressure
    2. Dissolved air
    3. Foaming
    4. Corrosion and rusting
j. Hydraulic fluid types
    1. Petroleum oils
    2. Oil-in-water emulsions
    3. Water-in-oil emulsions
    4. Water base glycols
    5. Chlorinated hydro-carbons
    6. Phosphate esters
    7. Silicons
    8. Silicate esters

Provide Practical Application On:

Identify types of hydraulic fluids.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Pippenger and Hicks, Industrial Hydraulics
c. Delmar, Electromechanical Technology Series, Fluids

Student Manuals:

Plant Engineering Training Systems, Basic Hydraulics, Lesson Two

Tools and Equipment:

Examples of types of hydraulic fluid

CLASSROOM HOURS 10

EVALUATION (FP-02)

Given a hydraulic fluid, the student will describe the fluid in terms of viscosity, chemical properties and fluid type. The completed task must be rated as acceptable according to the instructor's specifications.

TASK

FP-03 Identifying strainers and filters in hydraulic systems

PERFORMANCE OBJECTIVE

Identify strainers and filters in a hydraulic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Hydraulic system requirements
b. Removing contaminates
c. Degree of filtration
    1. Nominal
    2. Absolute
    3. Particle
d. Performance characteristics
e. Performance of different mediums
    1. Surface mediums
    2. Depth types
f. Strainers
    1. Mesh
    2. Primary use
    3. Reservoir strainers
    4. In line strainers
g. Filters
h. Fiber mediums
i. Magnetic mediums
j. Filter and strainer installations

Provide Practical Application On:

Identify several types of filters and strainers.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Pippenger and Hicks, Industrial Hydraulics
c. Delmar, Electromechanical Technology Series, Fluids

Student Manuals:

Plant Engineering Training Systems, Basic Hydraulics, Lesson Three

Tools and Equipment:

Several types of filters and strainers

CLASSROOM HOURS 10

EVALUATION (FP-03)

Given a selection of filters and strainers, the student will identify and describe each type and its function. The completed task must meet the instructor's specifications.

TASK

FP-04 Identifying reservoirs and accumulators in a hydraulic system

PERFORMANCE OBJECTIVE

Identify reservoirs and accumulators in a hydraulic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. System demands
    - 1. Function of a reservoir
    - 2. Function of an accumulator
- b. Fluid reservoir requirements
    - 1. Store a supply of hydraulic fluid.
    - 2. Break up foam.
    - 3. Settle heavy dirt, sludge and water.
    - 4. Cool the fluid.
    - 5. Mounting platform for pump and other equipment
- c. Baffles
- d. Air separation
- e. Reservoir cooling
- f. Liquid heat exchanger
- g. Reservoir accessories
    - 1. Pump intake strainers
    - 2. Suction gage
    - 3. Air breather
    - 4. Fluid level gage
    - 5. Thermometer
    - 6. The reservoir as support base for the power unit
- h. Accumulators
    - 1. Stores fluid under pressure until needed by system
    - 2. Absorbs hydraulic shocks
- i. Types of accumulators
    - 1. Weight loaded or gravity
    - 2. Spring-loaded piston

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Pease, Basic Fluid Power
- b. Pippenger and Hicks, Industrial Hydraulics
- c. Delmar, Electromechanical Technology Series, Fluids

Student Manuals:

- a. Plant Engineering Training Systems, Basic Hydraulic, Lesson Four
- b. Oregon, Reservoirs

Tools and Equipment:

Hydraulic system (or diagram)

CLASSROOM HOURS

10

EVALUATION (FP-04)

Given a hydraulic system, the student will identify reservoirs and accumulators and describe their purposes. The completed task must be rated as acceptable according to the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

3. Air bottle or non-separated gas
4. Bladder or bag
5. Diaphragm
6. Gas charged piston
7. Differential piston

TASK

FP-05 Identifying hydraulic pumps on a system

PERFORMANCE OBJECTIVE

Identify pumps on a hydraulic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of hydraulic pumps
b. Pump classifications
    1. Positive displacement
    2. Non-positive displacement
    3. Fixed or variable displacement
    4. Rotary
    5. Piston
    6. Radial piston
c. Rating selection factors
    1. Capacity
    2. Pressure
    3. Drive speed
    4. Efficiency
    5. Reliability
    6. Fluid characteristics
    7. Size and weight
    8. Control adaptability
    9. Life
    10. Installation and maintenance
d. Gear pumps
    1. External
    2. Internal
    3. Axial flow or screw
    4. Cycloidal
e. Vane pumps
f. Piston pumps
    1. Dexial piston
    2. Radial pistons
    3. Inlet and outlet check valve

Provide Practical Application On:

Identify types of pumps from live examples, illustrations or diagrams.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Pippenger and Hicks, Industrial Hydraulics
c. Delmar, Electromechanical Technology Series, Fluids

Student Manuals:

a. Plant Engineering Training Systems, Basic Hydraulics, Lesson Five
b. Oregon, Pumps

Tools and Equipment:

Pumps (live examples, illustrations or diagrams)

CLASSROOM HOURS 15

EVALUATION (FP-05)

Given diagrams of pumps, the student will accurately identify the type of pump and describe its use.

TASK

FP-06 Identifying piping, tubing and fittings

PERFORMANCE OBJECTIVE

Identify piping, tubing and fittings used in hydraulic systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Hydraulic piping
- b. Flow and velocity
  - 1. Laminar flow
  - 2. $\text{Velocity} = \dfrac{\text{flow (gpm)} \times 0.321}{\text{pipe area (sq. in.)}}$
- c. Hydraulic pressure
- d. Pressure loss
- e. Pipe fittings
- f. Threaded pipe
- g. Installing pipe
- h. Tubing
  - 1. Tube bending
  - 2. Tube fittings
- i. Hoses

Provide Practical Application On:

Choose the correct size pipe, fitting, coupling or hose for a job.

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Pease, Basic Fluid Power
- b. Pippenger and Hicks, Industrial Hydraulics
- c. Delmar, Electromechanical Technology Series, Fluids

Student Manuals:

Plant Engineering Training Systems, Basic Hydraulics, Lesson Six

Tools and Equipment:

- a. Pipe
- b. Tube
- c. Fittings
- d. Hose
- e. Tools for pipe fitting

CLASSROOM HOURS

15

EVALUATION (FP-06)

Given specifications for a job, the student will select the correct size pipe, fitting, coupling or hose and prepare the job for installation. The completed task must be in accordance with the instructor's specifications.

TASK

FP-07 Identifying directional control valves

PERFORMANCE OBJECTIVE

Identify directional control valves used in a hydraulic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of directional control valves
b. Manually operated valves
    1. Glove
    2. Plug
    3. Ball
    4. Needle
c. Automatic two-way valves
    1. Direct-acting
    2. Normally closed
    3. Pilot operated
d. Check valves
e. Spool valves
f. Fluid motor control
g. Normally open and normally closed three-way valves
h. Holding valves
i. Four-way valves
j. Five-way valves
k. Rotary valves
l. Valve actuators
m. Special valves and accessories

Provide Practical Application On:

Identify types of directional control valves on a diagram of a hydraulic system.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Pippenger and Hicks, Industrial Hydraulics
c. Delmar, Electromechanical Technology Series, Fluids

Student Manuals:

a. Plant Engineering Training Systems, Basic Hydraulics, Lesson Seven
b. Oregon, Directional Control Valve

Tools and Equipment:

Diagram of a hydraulic system

CLASSROOM HOURS 15

EVALUATION (FP-07)

Given a diagram of a hydraulic system, the student will accurately identify the types of directional control valves on the system using the diagram.

TASK

FP-08 Identifying pressure control valves

PERFORMANCE OBJECTIVE

Identify pressure control valves.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Pressure control valves
  1. Purpose
  2. Flow control
  3. Holding or sequence valve
b. Pressure relief valve
  1. Poppet or spool type
  2. Flow capacity
  3. Operating differential pressure
c. Spool valves
  1. Simple and direct acting spool valve
  2. Two-stage or compound
  3. Remote control
d. Sequence valves
e. Counter balance valves
f. Holding valves
g. Unloading valves
h. Pressure reducing valves
i. Shock suppressors
j. Flow control valves
k. Pressure compensation
l. Temperature compensation

Provide Practical Application On:

Identify and describe types of pressure control valves from illustrations or live examples.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Pippenger and Hicks, Industrial Hydraulics
c. Delmar, Electromechanical Technology Series, Fluids

Student Manuals:

a. Plant Engineering Training Systems, Basic Hydraulics Lesson Eight
b. Oregon, Pressure Relief Valves

CLASSROOM HOURS 15

EVALUATION (FP-08)

Given illustrations or live examples of pressure control valves, the student will correctly identify the type of valve and describe its purpose.

TASK

FP-09 Identifying cylinders in a hydraulic system

PERFORMANCE OBJECTIVE

Identify cylinders used in a hydraulic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Purpose of cylinders
- b. Double-acting cylinders
- c. Single-acting cylinder
  - 1. Ram
  - 2. Telescoping cylinders
- d. Two-piston cylinders
- e. Positional cylinders
- f. Cylinder construction
  - 1. Piston rings and seals
  - 2. Road packing
- g. Cylinder mounting
  - 1. Fixed
  - 2. Pivoted
  - 3. Centerline
  - 4. Non-centerline
- h. Selecting a cylinder
- i. Flow capacity
- j. Cushioning
- h. Selecting a cylinder
- i. Flow capacity
- j. Cushioning
- k. Piston rod strength

Provide Practical Application On:

Select the appropriate cylinder for a hydraulic system.

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Pease, Basic Fluid Power
- b. Pippenger and Hicks, Industrial Hydraulics
- c. Morrow, Maintenance Engineering Handbook
- d. Delmar, Electromechanical Technology Series, Fluids

Student Manuals:

- a. Plant Engineering Training Systems, Basic Hydraulics Lesson Nine
- b. Oregon, Cylinders

Tools and Equipment:

Cylinders

CLASSROOM HOURS 10

EVALUATION (FP-09)

Given specifications for a system which requires a cylinder, the student will select an appropriate cylinder for the system. The selection will be rated according to the instructor's specifications.

TASK

FP-10 Identifying hydraulic motors

PERFORMANCE OBJECTIVE

Identify hydraulic motors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of hydraulic motors
b. Classification of motors
    1. Positive displacement
    2. Fixed displacement
    3. Variable displacement
c. Rating and selection factors
    1. Pressure range
    2. Speed range
    3. Torque
    4. Horsepower
    5. Overall efficiency
    6. Volumetric efficiency
    7. Size, weight and mounting requirements of motor
    8. Reliability and service life
d. Hydraulic motor construction
e. Gear motors
    1. External
    2. Internal
    3. Non-separated
f. Vane motors
g. Piston motors
h. Rotary actuators

Provide Practical Application On:

Select an appropriate motor for a system.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Pippenger and Hicks, Industrial Hydraulics
c. Morrow, Maintenance Engineering Handbook
d. Delmar, Electromechanical Technology Series, Fluids

Student Manuals:

Plant Engineering Training Systems, Basic Hydraulics, Lesson Ten

Tools and Equipment:

Hydraulic motors

CLASSROOM HOURS 15

EVALUATION (FP-10)

Given specifications for a system and considering all rating factors, the student will select an appropriate motor. The selection will be rated by the instructor according to industry specifications.

TASK

FP-11 Identifying pneumatic principles

PERFORMANCE OBJECTIVE

Identifying basic principles of pneumatics.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Pneumatic power systems
    - 1. Pneumatic tools
    - 2. Linear motion devices
    - 3. Door openers
    - 4. Rotary motion devices
- b. Force, weight and mass
- c. Pressure
    - 1. Atmospheric
    - 2. Below atmospheric
    - 3. Pneumatic system pressure
- d. Work and energy
- e. Power
- f. Energy used in pneumatic systems
    - 1. Electrical
    - 2. Pneumatic
    - 3. Kinetic
    - 4. Potential
    - 5. Heat
- g. Diffusion and dispersion
- h. Separation of gases and liquids
- i. Compressibility
- j. Pneumatic laws
    - 1. Pascal's Law
    - 2. Boyle's Law
    - 3. Charles Law
    - 4. Ideal Gas Law
- k. Transmission of pneumatic fluid power
- l. Pneumatic leverage
- m. Air properties
- n. Air flow in pipes
- o. Viscosity of air
- p. Bernoulli's Principle
- q. Pneumatic power systems

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Pease, Basic Fluid Power
- b. Stewart and Storer, Fluid Power

Student Manuals:

- a. Plant Engineering Training Systems, Basic Pneumatics
- b. Bobbs-Merrill, Fluid Power

A/Vs:

Bobbs-Merrill, Transparency #97228, "Fluid Power"

CLASSROOM HOURS

10

EVALUATION (FP-11)

Given an overview of basic pneumatic power system principles, the student will correctly identify basic pneumatic principles and terminology.

TASK

FP-12 Identifying reciprocating compressors

PERFORMANCE OBJECTIVE

Identify and describe reciprocating compressors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Compressor operation
b. Compressor classification
    1. Positive displacement
    2. Dynamic
c. Reciprocating piston compressors
d. Single and double-acting compressors
e. Compressor construction
f. Horsepower cooling requirements
    1. Intercooling
    2. Aftercooler
    3. Water-cooled
    4. Counter-flow
    5. Parallel flow
g. Compressor lubrication
    1. Reduce friction
    2. Improve transfer of heat
    3. Splash or pressurized
h. Non-lubricated compressors
i. Compressor controls
    1. Unloading
    2. Holding type
    3. Suction unloader valves
    4. Centrifugal pressure release
    5. Electric or magnetic unloader

Provide Practical Application On:

Identify types of reciprocating compressors in the lab or in a plant.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Powers
b. Stewart and Storer, Fluid Power

A/Vs:

Bobbs-Merrill, Transparency #97228, "Fluid Power"

Student Manuals:

a. Plant Engineering Training Systems, Basic Pneumatics, Lesson Two
b. Bobbs-Merrill, Fluid Power

Tools and Equipment:

Several types of reciprocating compressors

CLASSROOM HOURS

15

EVALUATION (FP-12)

Given a reciprocating compressor, the student will accurately identify the type of compressor and describe it in terms of controls, lubrication requirements and application.

TASK

FP-13 Identifying rotary compressors

PERFORMANCE OBJECTIVE

Identify rotary compressors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Compressor classification
b. Compressor selection
c. Compressor accessories

Provide Practical Application On:

Identify rotary compressor.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

A/Vs:

Bobbs-Merrill, Transparency #97228, "Fluid Power"

Student Manuals:

a. Plant Engineering Training Systems, Basic Pneumatics, Lesson Three
b. Bobbs-Merrill, Fluid Power

Tools and Equipment:

Selection of several rotary compressors

CLASSROOM HOURS

15

EVALUATION (FP-13)

Given a rotary compressor, the student will accurately classify the compressor and describe its operation and application.

TASK

FP-14 Identifying primary air treatment in pneumatic systems

PERFORMANCE OBJECTIVE

Identify the method of primary air treatment in pneumatic systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Air treatment
b. Preliminary filtering
    1. Dry or wet filters
    2. Cleaning a filter
c. Relative humidity
    1. Temperature
    2. Weather
d. Effects of moisture
e. Water removal
    1. Condensers after coolers
    2. Water and air cooled
f. Dew point
g. Moisture separators
    1. Gravity separation
    2. Drain pluts -safety
h. Oil scrubbers
    1. Operation
    2. Maintenance
i. Air Dryers
    1. Delinquesent
    2. Adsorption
j. Air receivers

Provide Practical Application On:

Identify methods of air treatment in a pneumatic system.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

A/Vs:

Bobbs-Merrill, Transparency #97228, "Fluid Power"

Student Manuals:

a. Plant Engineering Training System, Basic Pneumatics, Lesson Four
b. Bobbs-Merrill, Fluid Power

Tools and Equipment:

Diagram of a pneumatic system

CLASSROOM HOURS

10

EVALUATION (FP-14)

Given a pneumatic system, the student will accurately identify and describe air treatment methods.

TASK

FP-15 Identifying secondary air treatment methods

PERFORMANCE OBJECTIVE

Identify methods of secondary air treatment.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Methods of treatment
b. Contaminant separation
c. Contaminant filtration
d. Filter classification and rating
e. Types of medium surface filters
f. Depth filters
g. Absorption filters
h. Lubricating

Provide Practical Application On:

Identify secondary air treatment methods used on a pneumatic system.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

A/Vs:

Bobbs-Merrill, Transparency #97228, "Fluid Power"

Student Manuals:

a. Plant Engineering Training Systems, Basic Pneumatics, Lesson Five
b. Bobbs-Merrill, Fluid Power

Tools and Equipment:

Diagram or live pneumatic system

CLASSROOM HOURS

5

EVALUATION (FP-15)

Given a pneumatic system, the student will accurately identify and describe secondary air treatment methods.

TASK

FP-16 Identifying piping, hoses and fittings used in pneumatic systems

PERFORMANCE OBJECTIVE

Identify the types of piping, hoses and fittings used in a pneumatic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Piping requirements
   1. Pipe, tubing, hose and fitting combinations
   2. Free of leaks
b. Air flow
   1. Streamlined
   2. Lominar flow
   3. Selection of pipe size
c. Piping
   1. Black steel pipe
   2. Bursting pressure
   3. Safety factor
   4. Threading, welding and flonging
d. Pipe applications
e. Metallic tubing
f. Tube bending
g. Tube fitting
h. Installation of tube
i. Non-metallic tubing
j. Hoses and fittings
k. Hose installation

Provide Practical Application On:

Install pipes, tubes or hoses on a pneumatic system.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

A/Vs:

Bobbs-Merrill, Transparency #97228, "Fluid Power"

Student Manuals:

a. Plant Engineering Training Systems, Basic Pneumatics Lesson Six
b. Bobbs-Merrill, Fluid Power

Tools and Equipment:

a. Pipe
b. Tube
c. Hose
d. Fittings and couplings
e. Tools

CLASSROOM HOURS

10

EVALUATION (FP-16)

Given appropriate tools, supplies and equipment, the student will accurately use the correct procedure to install pipe, hoses and tubing on a pneumatic system.

TASK

FP-17 Identifying control valves

PERFORMANCE OBJECTIVE

Identify control valves.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Control valves
b. Manually operated valves
c. Automatically operated valves
d. Check valves
    1. Flapper
    2. Poppet
    3. Ball
    4. Cracking pressure
e. Self-activated shuttle valves
f. Control valves
    1. Spool
    2. Poppet
    3. Reciprocating disc
    4. Rotary
g. Three-way valves
h. Four-way valves
i. Five-way valves
j. Valve accessories

Provide Practical Application On:

Identify types of valves from diagrams or live examples.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

A/Vs:

Bobbs-Merrill, Transparency #97228, "Fluid Power"

Student Manuals:

a. Plant Engineering Training Systems, Basic Pneumatics, Lesson Seven
b. Bobbs-Merrill, Fluid Power

Tools and Equipment:

Valves or diagrams of different types of valves

CLASSROOM HOURS 10

EVALUATION (FP-17)

Given a control valve or diagram, the student will correctly identify the valve and describe its purpose.

TASK

FP-18 Identifying pressure relief valves

PERFORMANCE OBJECTIVE

Identify pressure relief valves used in pneumatic systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Controlling pressure
b. Safety valves
c. Relief valves
d. Refill valve construction
e. Pressure regulators
f. Regulator modifications
g. Safety

Provide Demonstration On:

Setting or adjusting a regulator

Provide Practical Application On:

Identifying, setting or adjusting a regulator

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, *Basic Fluid Power*
b. Stewart and Storer, *Fluid Power*

A/Vs:

Bobbs-Merrill, Transparency #97228, "Fluid Power"

Student Manuals:

a. Plant Engineering Training Systems, *Basic Pneumatics, Lesson Eight*
b. Bobbs-Merrill, *Fluid Power*

CLASSROOM HOURS	10

EVALUATION (FP-18)

Given a pneumatic system with a pressure regulator, the student will correctly identify, set or adjust the valve according to the appropriate specifications.

TASK

FP-19 Identifying cylinders

PERFORMANCE OBJECTIVE

Identify cylinders used for pneumatic systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Pneumatic cylinders
b. Double-acting cylinders
c. Single-acting cylinders
d. Two-piston cylinders
e. Rod packings
f. Mounting
g. Selecting a cylinder
h. Cushioning
i. Piston rod strength

Provide Practical Application On:

Select a cylinder for a pneumatic system.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

A/Vs:

Bobbs-Merrill, Transparency #97228, "Fluid Power"

Student Manuals:

a. Plant Engineering Training Systems, Basic Pneumatics, Lesson Nine
b. Bobbs-Merrill, Fluid Power

Tools and Equipment:

a. Cylinders and specifications
b. Pneumatic system

CLASSROOM HOURS 5

EVALUATION (FP-19)

Given a pneumatic system and specifications, the student will correctly select the correct capacity cylinder for use with the system.

TASK

FP-20 Identifying motors

PERFORMANCE OBJECTIVE

Identify motors used on a pneumatic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Pneumatic motors
b. Motor classification
    1. Piston motors
    2. Vane motors
    3. Positive displacement
c. Rating and selection factors
    1. Pressure rating
    2. Speed range
    3. Torque
    4. Horsepower
    5. Size, weight and mounting
d. Motor construction
e. Piston motors
f. Rotary activators
g. Portable air tools
h. Air boosters

Provide Practical Application On:

Select a motor and install it on a pneumatic system.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

A/Vs:

Bobbs-Merrill, Transparency #97228, "Fluid Power"

Student Manuals:

a. Plant Engineering Training Systems, Basic Pneumatics, Lesson Ten
b. Bobbs-Merrill, Fluid Power

Tools and Equipment:

a. Motors
b. Pneumatic system
c. Tools

CLASSROOM HOURS

20

EVALUATION (FP-20)

Given a pneumatic system and specifications, the student will accurately select an appropriately rated motor and install the motor on the system.

TASK

EL-01 Defining terminology and analyzing theory associated with basic D.C. circuits

PERFORMANCE OBJECTIVE

Define terminology and analyze theory associated with basic D.C. circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Atom
b. Molecule
c. Nucleus
d. Neutron
e. Proton
f. Electron
g. Free electron
h. Conductor
i. Insulator
j. Electron theory
k. Sources of electron movement
l. Coulomb
m. Amphere
n. Joule
o. EMF (Voltage)
p. Work

(Continued on back)

Provide Demonstration On:

a. Electron theory
b. Sources of electron movement
c. Static electricity versus current electricity
d. Other information items as needed for terminology explanation

Provide Practical Application On:

Low voltage D.C. circuits as needed to facilitate terminology explanations

INSTRUCTIONAL MATERIALS

Textbooks:

a. Zebrowski, Physics for Technicians
b. Snow, Electrical Drafting and Design

A/Vs:

a. Audio Active, Tape #91294, "Basic Electricity Program"
b. Bergwall Productions, Filmstrip #801, "Basic Electricity and Electronics Explained - Direct Current"

Student Manuals:

McGraw-Hill, Basic Electricity

Tools and Equipment:

Pencil and loose leaf binder

CLASSROOM HOURS

12

EVALUATION (EL-01)

Given a prescribed terminology list and questions concerning D.C. theory, the student will define the terms and answer the questions with a minimum accuracy of 80%.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

q. Power
r. Watt
s. Ohm
t. Voltage drop
u. Series circuit
v. Parallel circuit
w. Magnetomotive force
x. Flux
y. Permeability
z. Reluctance
aa. Current
bb. Resistance

TASK

EL-02 Defining and converting electrical units associated with basic D.C. and A.C. circuits

PERFORMANCE OBJECTIVE

Define and convert electrical units associated with basic D.C. and A.C. circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

Converting from base units in ohms, volts, amperes, watts, hertz, farads, henries, meters and coulombs to metric conversion units of:

a. Micro
b. Milli
c. Kilo
d. Mega
e. Giga
f. Nano
g. Pico
h. Deci
i. Cent

Provide Demonstration On:

Chalkboard, overhead projector or filmstrip projector on unit conversions

Provide Practical Application On:

A.C. and D.C. circuits included in this course

INSTRUCTIONAL MATERIALS

Textbooks:

a. Tandy Corp., Electronics Data Book
b. Grob, Basic Electronics

A/Vs:

Audio Active, Tape #91294
"Basic Electricity Program"

Tools and Equipment:

a. Pencil and loose leaf binder
b. Electronic calculator with trig functions

CLASSROOM HOURS

12

EVALUATION (EL-02)

Given a list of electrical units, electrical unit conversion problems, an electronic calculator and necessary time, the student will define the units and convert the units with an accuracy of 80%.

TASK

EL-03 Calculating basic D.C. series circuits

PERFORMANCE OBJECTIVE

Calculate basic D.C. series circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Electron theory
b. Current flow
c. Coulomb
d. Joule
e. EMF (voltage)
f. Watts (power)
g. Resistance
h. Conductors
i. Ammeter
j. Voltmeter
k. Ohm's law
l. Schematic diagram
m. Kirchoff's laws
n. Voltage drop
o. Resistors in series
p. Sources of EMF
q. Insulators

(Continued on back)

Provide Demonstration On:

All information items using overhead and filmstrip projectors and chalkboard

Provide Practical Application On:

a. Series circuits wiring mock-ups illustrating all information items
b. Sample series circuits on handout sheets finding voltage, resistance, current and power

INSTRUCTIONAL MATERIALS

Textbooks:

Snow, *Electrical Drafting and Desing*

A/Vs:

a. Bergwall, Filmstrip #801, "Basic D.C."
b. Audio Active, Tape #91294, "Basic Electricity Program"

Student Manuals:

ESP, Inc., *Basic Electricity Program*, No. 91294

Tools and Equipment:

a. Pencil and loose leaf binder
b. Calculator with trig functions

CLASSROOM HOURS

12

EVALUATION (EL-03)

Given basic series D.C. circuit problems, an electronic calculator and necessary time, the student will calculate these problems with a minimum accuracy of 85%.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

r. Schematic symbols
s. Ohmmeter
t. Safety

TASK

EL-04 Calculating basic D.C. parallel circuits

PERFORMANCE OBJECTIVE

Calculate basic D.C. parallel series circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Ohm's law
b. Review of formula conversion
c. Joule
d. Coulomb
e. Current
f. Voltage
g. Resistance
h. Power
i. Fuses
j. Kirchoff's laws
k. Voltage drop
l. Conductance
m. Resistors in parallel
n. Schematic symbols
o. Ammeter

(Continued on back)

Provide Demonstration On:

All information items using overhead and filmstrip projectors and chalkboard

Provide Practical Application On:

a. Parallel circuits wiring mock-ups illustrating all information items
b. Sample parallel circuits on handout sheets finding voltage, resistance, current and power

INSTRUCTIONAL MATERIALS

Textbooks:

Grob, Basic Electronics

A/Vs:

a. Audio Active, Tape #91294, "Basic Electricity Program"
b. Bergwall Productions, Tape #801, "Basic Electricity and Electronics Explained - Direct Current"

Student Manuals:

a. McGraw-Hill, Basic Electricity
b. ESP, Basic Electricity Program No. 91294

Tools and Equipment:

a. Pencil and loose leaf binder
b. Calculator with trig functions

CLASSROOM HOURS 12

EVALUATION (EL-04)

Given basic parallel D.C. circuit problems, an electronic calculator and necessary time, the student will calculate these problems with a minimum accuracy of 85%.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

p. Voltmeter
q. Ohmmeter
r. Safety

TASK

EL-05 Calculating basic D.C. series parallel circuits

PERFORMANCE OBJECTIVE

Calculate basic D.C. series parallel circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Ohm's law
b. Review of formula conversion
c. Current
d. Voltage
e. Resistance
f. Power
g. Kirchoff's laws
h. Voltage drops
i. Conductance
j. Resistors in series
k. Resistors in parallel
l. Schematic symbols
m. Ammeters
n. Voltmeters
o. Ohmmeters
p. Safety

Provide Demonstration On:

All information items using overhead and filmstrip projectors and the chalkboard

Provide Practical Application On:

a. Series - parallel circuits, wiring mock-ups illustrating all information items
b. Sample series - parallel circuits on handout sheets finding voltage, resistance, current and power

INSTRUCTIONAL MATERIALS

Textbooks:

Grob, Basic Electronics

A/Vs:

a. Audio Active, Tape #91294, "Basic Electricity Program"
b. Bergwall Productions, Filmstrip #801, "Basic Electricity and Electronics Explained - Direct Current"

Student Manuals:

McGraw-Hill, Basic Electricity

Tools and Equipment:

a. Pencil and loose leaf binder
b. Electronic calculator with trig functions

CLASSROOM HOURS 12

EVALUATION (EL-05)

Given basic series-parallel circuit problems, an electronic calculator and necessary time, the student will calculate these problems with a minimum accuracy of 85%.

TASK

EL-06 Defining terminology and analyzing theory associated with basic A.C. circuits

PERFORMANCE OBJECTIVE

Define terminology and analyze theory associated with basic A.C. circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Alternators
b. Sinusoidal waves
c. Alternations
d. Magnitude vectors
e. Instantaneous values
f. RMS values
g. Average values
h. Hertz
i. Amplitude
j. Phase angle
k. Peak value
l. Effective value
m. Radians
n. Power factor
o. Watts
p. Inductance
q. Impedance

(Continued on back)

Provide Demonstration On:

Information items using the overhead and filmstrip projectors and chalkboard

Provide Practical Application On:

Low voltage A.C. circuits as needed to facilitate terminology explanations

INSTRUCTIONAL MATERIALS

Textbooks:

Grob, Basic Electronics

A/Vs:

a. Audio Active, Tape #91294, "Basic Electricity Program"
b. Bergwall Productions, Filmstrip #802, "Basic Electricity and Electronics Explained - Alternating Current"

Tools and Equipment:

Pencil and loose leaf binder

CLASSROOM HOURS 12

EVALUATION (EL-06)

Given a list of terminology items and questions associated with basic A.C. circuits, the student will define the terminology and answer questions with a minimum accuracy of 85%.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

r. Apparent and true power
s. Capacitance
t. Inductance reactance
u. Capacitive reactance
v. Conductance
w. Susceptance
x. Admittance
y. Transformer theory

TASK

EL-07 Calculating power factors, impedance and pure resistance in series A.C. circuits

PERFORMANCE OBJECTIVE

Calculate power factors, impedance and pure resistance in series A.C. circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Inductance
b. Inductance reactance
c. Capacitance and capacitance reactance
d. Impedance
e. Formulas for 1-4 above
f. Phase angles
g. D.C. and A.C. wave forms
h. Peak, effective and average values of A.C.
i. Ohm's law
j. Formulas for power and power factors
k. Schematic symbols
l. Frequency
m. Apparent and true power

(Continued on back)

Provide Demonstration On:

All information items using overhead and filmstrip projectors and chalkboard

Provide Practical Application On:

a. Circuits involving power factors, impedance and pure resistance in series circuits mock-ups
b. Sample circuits, handout sheets, power factors, impedance and pure resistance

INSTRUCTIONAL MATERIALS

Textbooks:

Grob, Basic Electronics

A/Vs:

a. Audio Active, Tape #91294, "Basic Electricity Program"
b. Bergwall Productions, Filmstrip #802, "Basic Electricity and Electronics Explained - Alternating Current"

Student Manuals:

Audio Active, Basic Electricity Program, No. 91294

Tools and Equipment:

a. Pencil and loose leaf binder
b. Electronic calculator with trig functions

CLASSROOM HOURS

12

EVALUATION (EL-07)

Given basic problems involving power factors, impedance, pure resistance in series A.C. circuits and electronic calculator, the student will calculate these problems with a minimum accuracy of 85%.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

n. Safety
o. Graphic solutions for
   circuit problems

TASK

EL-08 Calculating basic series A.C. circuits with inductance, reactance and resistance.

PERFORMANCE OBJECTIVE

Calculate basic series A.C. circuits with inductance, reactance and resistance.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Inductance and inductance reactance
b. Impedance
c. Formulas for above items
d. Phase angles
e. Frequency
f. Schematic symbols
g. Power and power factor formulas
h. Graphic solutions for circuit problems

Provide Demonstration On:

All information items using overhead and filmstrip projectors and chalkboard

Provide Practical Application On:

a. Series circuits involving inductance reactance and resistance in circuit mock-ups
b. Sample circuit handout sheets finding inductance reactance, voltage, current, impedance, resistance and phase angles in LR series A.C. circuits

INSTRUCTIONAL MATERIALS

Textbooks:

Grob, Basic Electronics

A/Vs:

a. Audio Active, Tape #91294, "Basic Electricity Program"
b. Bergwall Productions, Filmstrip #802, "Basic Electricity and Electronics Explained - Alternating Current"

Student Manuals:

Audio Active, Basic Electricity No. 91294

Tools and Equipment:

a. Pencil and loose leaf binder
b. Electronic calculator with trig functions

CLASSROOM HOURS

12

EVALUATION (EL-08)

Given basic problems involving series A.C. circuits with inductance reactance and resistance and an electronic calculator, the student will calculate these with a minimum accuracy of 85%.

TASK

EL-09 Calculating basic series A.C. circuits with capacitive reactance and resistance

PERFORMANCE OBJECTIVE

Calculate basic series A.C. circuits with capacitive reactance and resistance.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Capacitance and capacitive reactance
b. Impedance
c. Formulas for above items
d. Phase angles
e. Frequency
f. Schematic symbols
g. Power and power factor formulas
h. Graphic solution for circuit problems

Provide Demonstration On:

All information items using overhead, filmstrip projectors and chalkboard

Provide Practical Application On:

a. Series circuits involving capacitance reactance and resistance in circuit mock-ups
b. Sample circuit handout sheets finding capacitance reactance, voltage, current, impedance, resistance and phase angles in RC series A.C. circuits

INSTRUCTIONAL MATERIALS

Textbooks:

Grob, Basic Electronics

A/Vs:

a. Audio Active, Tape #91294, "Basic Electricity Program"
b. Bergwall Productions, Filmstrip #802, "Basic Electricity and Electronics Explained - Alternating Current"

Student Manuals:

Audio Active, Basic Electricity Program No. 91294

Tools and Equipment:

a. Pencil and loose leaf binder
b. Electronic calculator with trig functions

CLASSROOM HOURS

12

EVALUATION (EL-09)

Given basic problems involving series A.C. circuits with capacitance reactance and resistance and an electronic calculator, the student will calculate these with a minimum accuracy of 85%.

TASK

EL-10 Calculating series A.C. circuits with capacitive and inductive reactance and resistance

PERFORMANCE OBJECTIVE

Calculate series A.C. circuits with capacitive and inductive reactance and resistance.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Capacitance and capacitive reactance
b. Inductance and inductance reactance
c. Impedance
d. Formulas for the above
e. Phase angles
f. Frequency calculations
g. Schematic symbols
h. Power and power factor formulas
i. Graphic solution for circuit problems
j. Current and voltage calculations

Provide Demonstration On:

All information items using overhead and filmstrip projectors and chalkboard

Provide Practical Application On:

a. Series circuits involving inductive and capacitive reactance and resistance in circuit mock-ups
b. Sample circuit handout sheets finding capacitance reactance, inductive reactance, voltage, current, impedance, resistance and phase angles in LRC series A.C. circuits

INSTRUCTIONAL MATERIALS

Textbooks:

Grob, Basic Electronics

A/Vs:

a. Audio Active, Tape #91294, "Basic Electricity Program"
b. Bergwall Productions, Filmstrip #802, "Basic Electricity and Electronics Explained - Alternating Current"

Student Manuals:

Audio Active, Basic Electricity Program, No. 91294

Tools and Equipment:

a. Pencil and loose leaf binder
b. Electronic calculator with trig functions

CLASSROOM HOURS

12

EVALUATION (EL-10)

Given basic problems involving A.C. circuits with capacitive and inductive reactance and resistance and an electronic calculator, the student will calculate these with a minimum accuracy of 85%.

TASK

EL-11 Calculating basic impedance in parallel A.C. circuits

PERFORMANCE OBJECTIVE

Calculate basic impedance in parallel A.C. circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Capacitance and capacitive reactance
b. Inductance and inductive reactance
c. Impedance
d. Formulas for above
e. Phase angles
f. Frequency
g. Schematic symbols
h. Graphic solutions for circuits
i. Voltage and current calculations
j. Safety

Provide Demonstration On:

All information items using overhead and filmstrip projectors and chalkboard

Provide Practical Application On:

a. Parallel circuits involving impedance in A.C. parallel circuit mock-ups
b. Sample circuit handout sheets finding impedance, current and voltage in basic parallel A.C. circuits

INSTRUCTIONAL MATERIALS

Textbooks:

Grob, Basic Electronics

A/Vs:

a. Audio Active, Tape #91294, "Basic Electricity Program"
b. Bergwall Productions, Filmstrip #802, "Basic Electricity and Electronics Explained - Alternating Current"

Student Manuals:

Audio Active, Basic Electricity Program, No. 91294

Tools and Equipment:

a. Pencil and loose leaf binder
b. Electronic calculator with trig functions

CLASSROOM HOURS

12

EVALUATION (EL-11)

Given basic problems involving A.C. circuits with impedance and an electronic calculator, the student will calculate these with a minumum accuracy of 85%.

TASK

EL-12 Applying basic air conditioning circuit theory when drawing residential cable layouts from engineering sketches

PERFORMANCE OBJECTIVE

Supply basic air conditioning circuit theory when drawing residential cable layouts from engineering sketches.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Electrical code
b. Symbols and outlets
c. Circuits required
d. Conductor sizes and types
e. Lighting circuits
f. Special purpose outlets
g. TV, telephone and signal systems
h. Electric heating
i. Gas or oil heating
j. Service entrance calculations
k. Service entrances and equipment
l. Remote control lighting
m. Electrical standards
n. Existing residential cable layouts

Provide Demonstration On:

Circuit wiring

Provide Practical Application On:

a. Existing residential electrical systems
b. Classroom mock-up wiring circuits

INSTRUCTIONAL MATERIALS

Textbooks:

a. Mullin, Electrical Wiring-Residential
b. Snow, Electrical Drafting and Design

A/Vs:

a. Bergwall Productions, Filmstrip #803, "Electrical House Wiring Explained"
b. DCA Educational Productions, Transparency, "Residential Electrical Wiring"

Tools and Equipment:

a. Drafting kit
b. Electrical symbols template

CLASSROOM HOURS

12

EVALUATION (EL-12)

Given a residential floor plan, necessary electrical references, design sketches and drafting supplies, the student will apply basic air conditioning circuit theory when drawing residential cable layouts. The student must score a "B" or better on all items using "Design Drafting Grading Sheet."

TASK

EL-13 Applying basic air conditioning circuit theory when drawing commercial cable layouts from engineering sketches 202-13

PERFORMANCE OBJECTIVE

Apply basic air conditioning circuit theory when drawing commercial cable layouts from engineering sketches.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Commercial building plan and specifications
b. Electrical service
c. Branch circuit requirements
d. Low voltage remote lighting
e. Switch control of lighting circuits
f. Appliance circuits
g. Heating and cooling systems
h. Special circuits
i. Over-current protection
j. Drawing panelboards and schedules
k. Lighting layouts
l. National electrical code

Provide Demonstration On:

Circuit wiring

Provide Practical Application On:

a. Existing residential electrical systems
b. Classroom mock-up wiring circuits

INSTRUCTIONAL MATERIALS

Textbooks:

Mullin-Smith, Electrical Commercial Wiring

Student Manuals:

a. Underwriters' Laboratories, Electrical Appliance and Utilization Equipment Directory
b. Underwriters' Laboratories, Electrical Construction Materials Directory

Tools and Equipment:

Drafting kit

CLASSROOM HOURS 12

EVALUATION (EL-13)

Given a commercial floor plan, necessary electrical references, necessary design sketches and drafting supplies and equipment, the student will apply basic air conditioning circuit theory when drawing commercial cable layouts. The student must score a "B" or better on all items using the "Design Drafting Grading Sheet".

TASK

EL-14 Drawing electrical one-line diagrams from engineering sketches

PERFORMANCE OBJECTIVE

Draw electrical one-line diagrams from engineering sketches.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Definition and purpose
b. System selection
    1. Radial system
    2. Primary selective system
    3. Secondary selective system
    4. Primary selective, secondary network system
c. Information sources
d. Power transformer
e. Circuit breakers
f. Fuses
g. Connected loads
h. Metering devices
i. Miscellaneous devices
j. One-line diagram examples
k. Symbol standards
l. Checklist

Provide Demonstration On:

Techniques for layout and drawing one-line diagrams

Provide Practical Application On:

Existing one-line diagrams showing information items

INSTRUCTIONAL MATERIALS

Textbooks:

Snow, Electrical Drafting and Design

Tools and Equipment:

Drafting kit

CLASSROOM HOURS 12

EVALUATION (EL-14)

Given an engineering sketch of a one-line diagram, necessary symbol references and drafting supplies and equipment, the student will draw a one-line diagram. The student must score a "B" or better on all items using the "Design Drafting Grading Sheet".

TASK

EL-15 Drawing electrical elementary diagrams from engineering sketches

PERFORMANCE OBJECTIVE

Draw electrical elementary diagrams from engineering sketches.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Definition and purpose
b. Symbols
c. Relays
d. Solenoids
e. Mechanically operated switches
f. Selector switches
g. Overload relays for motor starters
h. Control power source
i. Steps in developing an elementary diagram
j. Manual motor control
k. Motor starting with start-stop push button stations
l. Two wire control circuits
m. Sequence control
n. Wire numbers on elementary diagrams
o. Wire requirements
p. Layout and drawing techniques

Provide Demonstration On:

Techniques for laying out and drawing elementary diagrams

Provide Practical Application On:

Existing elementary diagrams showing information items

INSTRUCTIONAL MATERIALS

Textbooks:

Snow, Electrical Drafting and Design

Tools and Equipment:

Drafting kit

CLASSROOM HOURS 12

EVALUATION (EL-15)

Given an engineering sketch of an electrical elementary diagram, necessary smybol references and drafting supplies and equipment, the student will draw an electrical elementary diagram. The student must score a "B" or better on all items using the "Design Drafting Grading Sheet".

TASK

EL-16 Drawing electronic schematic diagrams from engineering sketches

PERFORMANCE OBJECTIVE

Draw electronic schematic diagrams from engineering sketches.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Definition and purpose
b. Composition of diagrams
    1. Symbols and arrangement
    2. Signal and power flow
    3. Component identification
    4. Operating controls
c. Stage layouts
d. Switch circuitry
e. Logic diagrams
f. Filter and tuned circuits
g. Geometric systems layout
h. Simplified layouts
i. Relay circuits
j. Estimating space requirements
k. Schematic diagram practices and layout procedures
l. Integrated circuits
m. Reference information

Provide Demonstration On:

Techniques for laying out and drawing schematic diagrams

Provide Practical Application On:

Good and poor arrangements of schematic diagrams

INSTRUCTIONAL MATERIALS

Textbooks:

Lindsey, The Design and Drafting of Printed Circuit Boards

Tools and Equipment:

a. Drafting kit
b. Electronics schematic template

CLASSROOM HOURS 12

EVALUATION (EL-16)

Given an engineering sketch of an electronic schematic diagram, necessary symbol references and drafting supplies and equipment, the student will draw an electronic schematic diagram. The student must score a "B" or better on all items using the "Design Drafting Grading Sheet".

TASK

EL-17 Laying out, taping up and/or drawing basic printed circuit boards

PERFORMANCE OBJECTIVE

Layout, tape up and/or draw basic printed circuit boards.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Schematic diagrams
b. Printed circuitry processes
c. Materials
d. Specifications
e. Conductor and components
    1. Conductor size
    2. Termination areas
    3. Specialized conductors in termination tapes
    4. Films and grids
    5. Tape application
    6. Tape and termination pad selection
f. Printed board design
g. Printed board layout
h. Component mounting
i. Integrated circuit grouping
j. Multi-layer printed circuit boards
k. Assemble drawings and parts layout
l. Design reference information

Provide Demonstration On:

Techniques for laying out, taping up and/or drawing printed circuit boards

Provide Practical Application On:

Existing printed circuit boards showing good and poor arrangements

INSTRUCTIONAL MATERIALS

Textbooks:

Lindsey, The Design and Drafting of Printed Circuit Boards

Tools and Equipment:

a. Drafting kit
b. Dry transfer printed circuit board art work materials
c. Chartpak
d. Printed circuit board template

CLASSROOM HOURS 12

EVALUATION (EL-17)

Given a basic electronic schematic, reference data, printed circuit art work supplies and drafting supplies and equipment, the student will layout, tape up and/or draw the foil and component side art work necessary for fabricating a printed circuit board. The student must score a "B" or better on all items using the "Design Drafting Grading Sheet".

TASK

EL-18 Planning and performing site work for a small industrial facility

PERFORMANCE OBJECTIVE

Complete plot plan and site work for a small industrial facility.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Location of utilities on building site
b. Location of building on plot plan
c. Property lines
d. Prepare location of electrical service
e. Voltage and transformer bank for industrial service
f. Overhead and underground service installation

Provide Demonstration On:

a. Voltage and KVA rating of transformers
b. Transformer hook-up
c. Overhead and underground service entrance
d. Transformer installation

Provide Practical Application On:

a. Planning site work
b. Location and installation of service equipment as per specifications and NEC
c. Transformer hook-up and installation

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft-Carr-Watt
b. Graham
c. Summers

A/Vs:

Bergwall Productions, Inc., Filmstrip #804A, "Planning and Roughing In"

Tools and Equipment:

a. Set of prints
b. Set of specifications
c. Engineer scale

CLASSROOM HOURS

12

EVALUATION (EL-18)

From a given set of prints and the electrical specifications, the student will accurately determine:

a. Service locations
b. Service overhead/underground
c. Location of transformer
d. Proper bank of transformers
e. The correct service voltage
f. Determine any conflicts with other utilities.

TASK

EL-19 Making calculations for electric motors, welders and heaters

PERFORMANCE OBJECTIVE

Make calculations for electric motors (480v 3 phase, 208v 3 phase, 208v 1 phase, 120v 1 phase) and welders.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Motor nameplate information
b. Single phase motors
c. Three phase motors
d. Three phase and single phase motor operations
e. Welder nameplate information
f. Single phase welders
g. Three phase welders
h. Welder operation
i. NEC article 430, 630, 220, 424
j. Heater nameplate information
k. Single phase electric heaters
l. Three phase electric heaters

Provide Demonstration On:

a. Operation of single phase and three phase motor and welders
b. Motor nameplate information
c. Welder nameplate information
d. Operation of single and three phase heaters
e. Heater nameplate information
f. Load calculations

Provide Practical Application On:

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Summers

A/Vs:

Hobar Publications, Slide/tape #471, "Electric Motors: Enclosures, Bearings and Mounting Methods

Tools and Equipment:

a. Set of prints with motor and welder load
b. NEC

CLASSROOM HOURS 12

EVALUATION (EL-19)

From a given set of prints, the student will accurately calculate the total connected motor, welder and heat load to determine the correct branch circuit wire size and feeder wire size for each.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

a. Motor branch circuit and
   feeder calculations
b. Welder branch circuit and
   feeder calculations
c. Heater branch circuit and
   feeder calculations
d. Selection of branch circuit
   and feeder wire size

TASK

EL-20 Selecting the correct transformer bank

PERFORMANCE OBJECTIVE

Complete the necessary calculations to determine the size and type of transformer bank.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Transformer selection application
b. Installation
c. Load calculations
d. Panel selection
e. Wire size and type
f. Conduit selection
g. Service grounding
h. Grounding wire size selection
i. Length of panel bus bars

Provide Demonstration On:

a. Transformer selection
b. Load calculations
c. Panel bus bar length

Provide Practical Application On:

Transformer installation and hook-up

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's catalog
b. Summers

Tools and Equipment:

a. Set of prints with loads
b. NEC equipment catalog

CLASSROOM HOURS

12

EVALUATION (EL-20)

Given necessary materials, the student will make calculations to determine the correct KVA size transformer needed to supply and operate a small industrial facility. The student will accurately make wiring connections necessary for proper operation of the transformer. All completed work must meet NEC specifications.

TASK

EL-21 Operating a split phase motor

PERFORMANCE OBJECTIVE

Operate and check the start and run characteristics of a split phase motor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Motor operation and winding
b. Motor nameplate
c. Load characteristics
d. Torque characteristics
e. Dual volts motors
f. Efficiency
g. Applications

Provide Demonstration On:

a. Direction of rotation of single phase motor
b. Load characteristics of a split phase motor
c. Torque characteristics of split phase motor
d. Applications of split phase motors

Provide Practical Application On:

a. Direction of rotation of single phase motor
b. Load characteristics of a split phase motor
c. Torque characteristics of split phase motors
d. Applications of split phase motors

INSTRUCTIONAL MATERIALS

Textbooks:

a. Veinott
b. Rosenberg
c. Croft-Carr-Watt

A/Vs:

AAVIM, Slide/tape, AV300, "How Electric Motors Start and Run"

Student Manuals:

a. Hampden
b. Georgia, Industrial Electricity, Industrial Wiring, Unit IW-20

Tools and Equipment:

a. Shop tools
b. Meters A.C. volt-amp-watt
c. Motor and equipment
d. Motor standards
e. Power supply
f. Motor loads

CLASSROOM HOURS

12

EVALUATION (EL-21)

Given a split phase motor and necessary test equipment and power supply, the student will accurately operate and check the following motor characteristics: torque, start amps, full load amps, speed and efficiency. Use NEAM standards for comparison.

TASK

EL-22 Operating a capacitor start motor

PERFORMANCE OBJECTIVE

Operate and check the start and run characteristics of a capacitor start motor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Motor capacitor
b. Motor nameplate
c. Motor operation and winding
d. Torque characteristic
e. Load characteristic

Provide Demonstration On:

How to operate, hook-up and calculate the load characteristics of capacitor motors

Provide Practical Application On:

a. Determining starting characteristics of a capacitor start motor
b. Determining load characteristics of a capacitor motor
c. Determining torque characteristics of a capacitor

INSTRUCTIONAL MATERIALS

Textbooks:

a. Veinott
b. Rosenberg
c. Croft-Carr-Watt

A/Vs:

AAVIM, Slide/tape, AV300, "How Electric Motors Start and Run"

Student Manuals:

a. Hampden
b. Georgia, Industrial Electricity, Industrial Wiring, Unit IW-22

Tools and Equipment:

a. Shop tools
b. Meters A.C. volt-amp-watt
c. Motor and equipment
d. Motor standards
e. Power supply
f. Motor loads

CLASSROOM HOURS

12

EVALUATION (EL-22)

Given a capacitor start motor and necessary test equipment and power supplies, the student will accurately operate and check the following motor characteristics: torque, start amps, full load amps, speed and efficiency. Use NEAM standards for comparison.

TASK

EL-23 Operating a universal motor

PERFORMANCE OBJECTIVE

Operate and check the start and run characteristics of a universal motor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Universal motor
b. Motor nameplate
c. A.C. operation
d. D.C. operation
e. Forward/reverse operation
f. Load characteristic
g. Speed control
h. Applications
i. Motor efficiency A.C./D.C.

Provide Demonstration On:

Hooking up, operating and checking the characteristics of a universal motor.

Provide Practical Application On:

a. Forward/reverse operation of motor
b. Speed control
c. DC operation of motor
d. AC operation of motor

INSTRUCTIONAL MATERIALS

Textbooks:

a. Veinott
b. Rosenberg
c. Adams

A/Vs:

AAVIM, Slide/tape, AV300, "How Electric Motors Start and Run"

Student Manuals:

Georgia, Industrial Electricity, Industrial Wiring, Unit IW-25

Tools and Equipment:

a. Shop tools
b. Meters A.C. and D.C. volt-amp-watt
c. Motor and equipment
d. Motor standards
e. Power supplies AC and DC
f. Motor loads

CLASSROOM HOURS

12

EVALUATION (EL-23)

Given a universal motor, necessary test equipment and A.C. and D.C. power supplies, the student will accurately hook-up, operate and check the following motor characteristics: torque, start amps, full load amps, speed and efficiency. Use NEAM standards for comparison.

TASK

EL-24 Operating an induction regulator

PERFORMANCE OBJECTIVE

Hook-up and test under load an induction regulator.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Induction regulator
b. Transformers

Provide Demonstration On:

Making connections for and operating a three phase induction regulator

Provide Practical Application On:

a. Induction regulator
b. Volts-output
c. Amp-output
d. Load capability

INSTRUCTIONAL MATERIALS

Textbooks:

a. Van Volkenburgh
b. Siskind (1)
c. Pender-Del Mar

Student Manuals:

a. Standard Electric Time Bulletin
b. Georgia, Industrial Electricity, Industrial Wiring, Unit IW-41

Tools and Equipment:

a. Motor generator set
b. Shop tools
c. Meters (VOM)
d. A.C. amp-meter
e. Power supply

CLASSROOM HOURS

12

EVALUATION (EL-24)

Given the required machinery, control equipment, components, necessary test equipment and power supplies, the student will accurately make the wiring connections and operate the three-phase induction regulator at 220-440 volts. The load may be resistive or inductive.

TASK

EL-25 Operating a rotary frequency changer

PERFORMANCE OBJECTIVE

Hook-up and operate a frequency changer 0-60 cycles 220v and 60-120 cycles 215-440 volts.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Frequency changers
b. Driven with synchronous field
c. Driven against synchronous field
d. RPM of frequency changers

Provide Demonstration On:

Making wiring connections for and operating a frequency changer

Provide Practical Application

a. Operation of frequency changers
b. Operation with synchronous field
c. Operation against synchronous field
d. Rotation of frequency changer
e. RPM of frequency changer
f. Motor driver

INSTRUCTIONAL MATERIALS

Textbooks:

Croft-Carr-Watt

Student Manuals:

a. Standard Electric Time Bulletin
b. Georgia, Industrial Electricity, Industrial Wiring, Unit IW-42

Tools and Equipment:

a. Motor/generator set
b. Shop tools
c. Meters VOM, frequency counter
d. Power supply

CLASSROOM HOURS 12

EVALUATION (EL-25)

Given the required machinery, control components, necessary test equipment and power supplies, the student will accurately make the wiring connections and operate the 3 phase frequency changer with rotor driven synchronous field rotation 0-60 cycles - 220 volts. The student will operate the 3 phase frequency changer driven against synchronous field rotation 60-120 cycles 215-440 volts.

TASK

EL-26 Operating a rotary converter

PERFORMANCE OBJECTIVE

Hook-up and operate a rotary converter (D.C. to A.C.)

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Rotary converters
b. Operation of rotary converters
c. Converting D.C. to A.C.

Provide Demonstration On:

Converting D.C. to A.C.

Provide Practical Application On:

a. Operation of a rotary converter
b. Converting A.C. to D.C.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pender-Del Mar
b. Siskind (1)
c. Siskind (2)

A/Vs:

Bergwall Productions, Inc., Filmstrips/cassettes, #810, "Rotary Machinery Explained-Direct Current Motors"

Student Manuals:

a. *Standard Electric Time Bulletin*
b. Georgia, *Industrial Electricity*, *Industrial Wiring*, Unit IW-44

Tools and Equipment:

a. Motor/generator
b. Shop tools
c. Meter VOM
d. Load
e. Amp-meter
f. Power supply

CLASSROOM HOURS

12

EVALUATION (EL-26)

Given the required machinery and control components, the student will accurately make the wiring connections and operate a rotary converter (DC to AC). The student will test the rotary converter with a 7 amp load at 70 volts 3 phase.

SECTION VI

REFERENCES, RESOURCES

RESOURCES

Instructional Resource Matrix

The Instructional Resource Matrix lists the instructional resources required to carry out the learning activities in each unit in the program. The resources are divided into the categories of audio visuals, textbooks and student materials.

Audio visuals are identified by the following symbols: slide/tapes (ST), filmstrips (FS) and transparencies (T).

Textbooks are identified by the author(s)/publisher and title.

Textbook List

This list identifies the textbooks referenced in the Unit Guide section and on the Instructional Resource Matrix.

Audio Visuals

The suppliers of the audio visuals referenced in the Unit Guides and the Instructional Resource Matrix are listed.

Additional Instructional Resources

This section lists instructional resources which may be used in addition to those primary resources listed on the Unit Guides.

Resource Addresses

Addresses of instructional materials referenced on the Unit Guides and in the Additional Instructional Resources section are given.

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Materials of Industry

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
MI-01 Identifying non-metal materials		Olivic and Olivio: Fundamentals of Applied Physics	Plant Engineering Training Systems: Non-Metal Materials, Lesson One
MI-02 Identifying properties of plastics	Bobbs-Merrill: "Foam Molding"; "Injection Molding"; "Polymer Structure"; "Reinforced Plastics"; "Rotational Molding"; "Thermoforming" (FS)	Schmidt: Basic Plastics; Richardson: Modern Industrial Plastics	Plant Engineering Training Systems: Non-Metal Materials, Lesson Two
MI-03 Identifying properties of rubber		Smith: Materials of Construction	Plant Engineering Training Systems: Non-Metal Materials, Lesson Three
MI-04 Identifying properties and applications of carbon		Smith: Materials of Construction	Plant Engineering Training Systems: Non-Metal Materials, Lesson Four
MI-05 Identifying industrial chemicals and their applications		Smith: Materials of Construction	Plant Engineering Training Systems: Non-Metal Materials, Lesson Five
MI-06 Identifying paints, coatings and their applications		Smith: Materials of Construction	Plant Engineering Training Systems: Non-Metal Materials, Lesson Six
MI-07 Identifying insulating materials and their applications		Smith: Materials of Construction	Plant Engineering Training Systems: Non-Metal Materials, Lesson Seven
MI-08 Identifying properties and applications of construction materials.	DCA Educational Products: "Brick and Stone Masonry" (TR)	Dezettel: Masons and Stone Builders Library; Smith: Materials of Construction	Plant Engineering Training Systems: Non-Metal Materials, Lesson Eight

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Materials of Industry

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
MI-09 Identifying properties and applications of wood	Hobar: "Wood Technology" (FS)	Smith: Materials of Construction	Plant Engineering Training Systems: Non-Metal Materials, Lesson Nine
MI-10 Identifying adhesives and tapes		Smith: Materials of Construction	Plant Engineering Training Systems: Non-Metal Materials, Lesson Ten
MI-11 Identifying the physical structure of metals		Feirer: Metalwork: Johnson: Technical Metals	Plant Engineering Training Systems: Metal Materials, Lesson One
MI-12 Identifying properties of metals		Feirer: Metalwork: Johnson: Technical Metals	Plant Engineering Training Systems: Metal Materials, Lesson Two
MI-13 Identifying methods of heat treatment		Feirer: Metalwork: Johnson: Technical Metals	Plant Engineering Training Systems: Metal Materials, Lesson Three
MI-14 Identifying metal manufacturing processes	Career Aids, Inc.: "Foundry Work" (FS)	Feirer: Metalwork: Johnson: Technical Metals	Plant Engineering Training Systems: Metal Materials, Lesson Four
MI-15 Identifying iron manufacturing processes		Feirer: Metalwork: Johnson: Technical Metals	Plant Engineering Training Systems: Metal Materials, Lesson Five
MI-16 Identifying processes used to produce steel		Feirer: Metalwork: Johnson: Technical Metals	Plant Engineering Training Systems: Metal Materials, Lesson Six
MI-17 Identifying processes used to produce aluminum		Feirer: Metalwork: Johnson: Technical Metals	Plant Engineering Training Systems: Metal Materials, Lesson Seven

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Materials of Industry

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
MI-18 Identifying processes for the production of magnesium and titanium		Feirer: Metalwork: Johnson: Technical Metals	Plant Engineering Training Systems: Metal Materials, Lesson Eight
MI-19 Identifying processes used to produce copper		Feirer: Metalwork: Johnson: Technical Metals	Plant Engineering Training Systems: Metal Materials, Lesson Nine
MI-20 Identifying processes used to produce lead, nickel, tin and zinc		Feirer: Metalwork: Johnson: Technical Metals	Plant Engineering Training Systems: Metal Materials, Lesson Ten

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Drafting

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
D-01 Hand lettering	Barr Films: Drafting Series I 75000, "Lettering" (FS)	French and Svensen: Mechanical Drawing; Giesecke, Mitchell, Spencer, Hill and Dygdon: Technical Drawing; Jensen and Helsel: Fundamentals of Engineering Drawing; French: Engineering Drawing	Lawrence E. Gerevas: Drafting Technology Problems; Ames Lettering Guide Pamphlet
D-02 Freehand sketching		French and Svensen: Mechanical Drawing; Giesecke, Mitchell, Spencer, Hill and Dygdon: Technical Drawing; Jensen and Helsel: Fundamentals of Engineering Drawing	
D-03 Analyzing drawings for acceptable drafting practice		Giesecke, Mitchell, Spencer, Hill and Dygdon: Technical Drawing; Jensen and Helsel: Fundamentals of Engineering Drawing; French: Engineering Drawing; Spence: Basic Industrial Drafting; French and Svensen: Mechanical Drawing	

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Drafting

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
D-04 Drawing plane figures		Giesecke, Mitchell, Spencer, Hill and Dygdon: Technical Drawing; Jensen and Helsel: Fundamentals of Engineering Drawing; French: Engineering Drawing; Spence: Basic Industrial Drawing; French and Svensen: Mechanical Drawing	Gerevas: Drafting Technology Problems
D-05 Drawing with line contrast		Giesecke, Mitchell, Spencer, Hill and Dygdon: Technical Drawing; Jensen and Helsel: Fundamentals of Engineering Drawing; French: Engineering Drawing; Spence: Basic Industrial Drawing; French and Svensen: Mechanical Drawing	Gerevas: Drafting Technology Problems
D-06 Drawing to scale		Giesecke, Mitchell, Spencer, Hill and Dygdon: Technical Drawing; Jensen and Helsel: Fundamentals of Engineering Drawing; French: Engineering Drawing; Spence: Basic Industrial Drawing; French and Svensen: Mechanical Drawing	Gerevas: Drafting Technology Problems

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Drafting

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
D-07 Drawing in orthographic	Barr Films: Drafting Series I, "Shape Description" (FS)	Giesecke, Mitchell, Spencer, Hill and Dygdon: Technical Drawing; Jensen and Helsel: Fundamentals of Engineering Drawing; French: Engineering Drawing; Spence: Basic Industrial Drawing; French and Svensen: Mechanical Drawing	Gerevas: Drafting Technology Problems
D-08 Dimensioning	Barr Films: Drafting Series I, "Size Description" (FS)	Giesecke, Mitchell, Spencer, Hill and Dygdon: Technical Drawing; Jensen and Helsel: Fundamentals of Engineering Drawing; French: Engineering Drawing; Spence: Basic Industrial Drawing; French and Svensen: Mechanical Drawing	Gerevas: Drafting Technology Problems
D-09 Drawing in isometric	Barr Films: Drafting Series I, "Isometric Drawing" (FS)	Giesecke, Mitchell, Spencer, Hill and Dygdon: Technical Drawing; Jensen and Helsel: Fundamentals of Engineering Drawing; French: Engineering Drawing; Spence: Basic Industrial Drawing; French and Svensen: Mechanical Drawing	

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Drafting

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
D-10 Drawing auxiliary views	Barr Films: Drafting Series II, "Auxiliary Views" (FS)	Hawk: Descriptive Geometry; Hoelscher, Springer and Dobrovolny: Graphics for Engineers; French and Vierck: Engineering Drawing and Graphic Technology; Spence: Basic Industrial Drafting; Jensen and Helsel: Fundamentals of Engineering Drawing	Minor C. Hawk: Descriptive Geometry
D-11 Drawing fundamental views		Hawk: Descriptive Geometry; Heolscher, Springer and Dobrovolny: Graphics for Engineers: Luzadder: Fundamentals of Engineering Drawing; Warner and McNeary: Applied Descriptive Geometry	Minor C. Hawk: Descriptive Geometry
D-12 Connecting skew lines		Hawk: Descriptive Geometry; Warner and McNeary: Applied Descriptive Geometry	Minor C. Hawk: Descriptive Geometry
D-13 Finding piercing points		Hawk: Descriptive Geometry; Warner and McNeary: Applied Descriptive Geometry	Minor C. Hawk: Descriptive Geometry

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Drafting

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
D-14 Drawing plane intersections		Hawk: *Descriptive Geometry*; Hoelscher, Springer and Dobrovolny: *Graphics for Engineers*; Warner and McNeary: *Applied Descriptive Geometry*; Giesecke, Mitchell, Spencer, Hill and Dygdon: *Technical Drawing*	Minor C. Hawk: *Descriptive Geometry*
D-15 Determining dihedral angle		Hawk: *Descriptive Geometry*; Hoelscher, Springer and Dobrovolny: *Graphics for Engineers*; Warner and McNeary: *Applied Descriptive Geometry*; Luzadder: *Fundamentals of Engineering Drawing*	Minor C. Hawk: *Descriptive Geometry*
D-16 Determining true length with revolution		Hawk: *Descriptive Geometry*; Hoelscher, Springer and Dobrovolny: *Graphics for Engineers*; Warner and McNeary: *Applied Descriptive Geometry*; Luzadder: *Fundamentals of Engineering Drawing*; Giesecke, Mitchell, Spencer, Hill and Dygdon: *Technical Drawing*	Minor C. Hawk: *Descriptive Geometry*

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Drafting

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
D-17 Drawing intersecting solids		Hawk: Descriptive Geometry; Hoelscher, Springer and Dobrovolny: Graphics for Engineers; French and Vierck: Engineering Drawing and Graphic Technology; Luzadder: Fundamentals of Engineering Drawing; Spence: Basic Industrial Drafting; Jensen and Helsel: Fundamentals of Engineering Drawing	Hawk: Descriptive Geometry
D-18 Drawing developments		Hawk: Descriptive Geometry; Betterley: Sheet Metal Drafting; Hoelscher, Springer and Dobrovolny: Graphics for Engineers; French and Vierck: Engineering Drawings and Graphic Technology; Luzadder: Fundamentals of Engineering Drawing; Spence: Basic Industrial Drafting; Jensen and Helsel: Fundamentals of Engineering Drawing	Hawk: Descriptive Geometry

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Drafting

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
D-19 Drawing fasteners	Barr Films: Drafting Series II, "Fasteners" (FS)	Coover and Helsel: Programmed Blueprint Reading; Giesecke, Mitchell, Spencer, Hill and Dygdon: Technical Drawing; Jensen and Helsel: Fundamentals of Engineering Drawing; French: Engineering Drawing; Spence: Basic Industrial Drafting; Luzadder: Fundamentals of Engineering Drawing	Coover-Helsel: Programmed Blueprint Reading; Gerevas: Drafting Technology Problems
D-20 Drawing welds		Giesecke, Mitchell, Spencer, Hill and Dygdon: Technical Drawing; Jensen and Helsel: Fundamentals of Engineering Drawing; French: Engineering Drawing; Spence: Basic Industrial Drafting; Luzadder: Fundamentals of Engineering Drawing; French and Svensen: Mechanical Drawing	Gerevas: Drafting Technology Problems .
D-21 Dimensioning tolerances		Giesecke, Mitchell, Spencer, Hill and Dygdon: Technical Drawing; Jensen and Helsel: Fundamentals of Engineering Drawing; French: Engineering Drawing; Spence: Basic Industrial Drafting; Luzadder: Fundamentals of Engineering Drawing; French and Svensen: Mechanical Drawing	Gerevas: Drafting Technology Problems; Coover and Helsel: Programmed Blueprint Reading

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Drafting

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
D-22 Drawing gears		Giesecke, Mitchell, Spencer, Hill and Dygdon: Technical Drawing; Jensen and Helsel: Fundamentals of Engineering Drawing; French: Engineering Drawing; Spence: Basic Industrial Drafting; Luzadder: Fundamentals of Engineering Drawing; French and Svensen: Mechanical Drawing	Gerevas: Drafting Technology Problems
D-23 Drawing cams		Giesecke, Mitchell, Spencer, Hill and Dygdon: Technical Drawing; Jensen and Helsel: Fundamentals of Engineering Drawing; French: Engineering Drawing; Spence: Basic Industrial Drafting; Luzadder: Fundamentals of Engineering Drawing; French and Svensen: Mechanical Drawing	Gerevas: Drafting Technology Problems
D-24 Drawing details	Barr Films: Drafting Series II, "Assembly and Detail Drawings" (FS)	Giesecke, Mitchell, Spencer, Hill and Dygdon: Technical Drawing; Jensen and Helsel: Fundamentals of Engineering Drawing; French: Engineering Drawing; Spence: Basic Industrial Drafting; Luzadder: Fundamentals of Engineering Drawing; French and Svensen: Mechanical Drawing	

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Drafting

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
D-25 Drawing assemblies	Barr Films: Drafting Series II, "Assembly and Detail Drawings" (FS)	Giesecke, Mitchell, Spencer, Hill and Dygdon: Technical Drawing; Jensen and Helsel: Fundamentals of Engineering Drawing; French: Engineering Drawing; Spence: Basic Industrial Drafting; Luzadder: Fundamentals of Engineering Drawing; French and Svensen: Mechanical Drawing	Gerevas: Drafting Technology Problems
D-26 Drawing charts		Giesecke, Mitchell, Spencer, Hill and Dygdon: Technical Drawing; Jensen and Helsel: Fundamentals of Engineering Drawing; French: Engineering Drawing; Spence: Basic Industrial Drafting; Luzadder: Fundamentals of Engineering Drawing	Gerevas: Drafting Technology Problems
D-27 Drawing graphs		Giesecke, Mitchell, Spencer, Hill and Dygdon: Technical Drawing; Luzadder: Fundamentals of Engineering Drawing	
D-28 Sketching designs		Giesecke, Mitchell, Spencer, Hill and Dygdon: Technical Drawing	

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Drafting

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
D-29 Drawing sections	Barr Films: Drafting Series I: "Sections" (FS)	Giesecke, Mitchell, Spencer, Hill and Dygdon: Technical Drawing; Jensen and Helsel: Fundamentals of Engineering Drawing; French: Engineering Drawing; Spence: Basic Industrial Drafting; French and Svensen: Mechanical Drawing	Gerevas: Drafting Technology Problems

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Manufacturing Processes

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
Laying out metal surfaces	Bergwall: #505, "Bench Metalwork" (FS); Prentice-Hall Media: #VD930-1, "Machine Shop: Bench Operations" (FS)	Burghardt: Machine Tool Operation, Part I; Porter: Machine Operations and Setups; Nicholson: Shop Theory	Ohio: Machine Trades I, Benchwork Assignment Sheet #1
Identifying jig buttons		Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Benchwork Assignment Sheet #2
Using the sine bar	Bergwall: #503, "Measuring Tools Explained" (FS)	Burghardt: Machine Tool Operation, Part I; Porter: Machine Operations and Setups; Nicholson: Shop Theory	Ohio: Machine Trades I, Benchwork Assignment Sheet #3; Machine Shop Training Course, Vol. I
Using the bevel protractor	Bergwall: #503, "Measuring Tools Explained" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups	Ohio: Machine Trades I, Benchwork Assignment Sheet #4
Using steel rub	Bergwall: #505-1, "Bench Metal Work" (FS); Prentice-Hall: #VD930-1, "Machine Shop: Bench Operations" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Nicholson: Shop Theory	Ohio: Machine Trades I, Benchwork Assignment Sheet #5
Using the micrometer	Bergwall: #503-2, 3, and 4, "Measuring Tools Explained" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Nicholson: Shop Theory	Ohio: Machine Trades I, Benchwork Assignment Sheet #6

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Manufacturing Processes

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio Visuals	Textbooks	Student Materials
MP-07	Reading a vernier scale	Bergwall: #503-1, "Measuring Tools Explained" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Colvin: American Machinists' Handbook; Nicholson: Shop Theory	Ohio: Machine Trades I, Bench Work Assignment Sheet #7
MP-08	Using dial indicators, center testers and speed indicators	Bergwall: #503-5, "Measuring Tools Explained" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Nicholson: Shop Theory	Ohio: Machine Trades I, Bench Work Assignment Sheet #8; Machine Shop Training Course, Vol. I
MP-09	Using precision gage blocks, tapered ring, plug and snap gages	Bergwall: #503-4, "Measuring Tools Explained" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Nicholson: Shop Theory; Oberg: Machinery's Handbook	Ohio: Machine Trades I, Bench Work Assignment Sheet #9; Machine Shop Training Course, Vol. I
MP-10	Identifying and using hand hacksaws	Bergwall: #505-2, "Bench Metal Work" (FS); Prentice-Hall: #VD930-2, "Machine Shop: Bench Operation" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Nicholson: Shop Theory; Colvin: American Machinists' Handbook	Ohio: Machine Trades I, Bench Work Assignment Sheet #10

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Manufacturing Processes

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio Visuals	Textbooks	Student Materials
MP-11	Using abrasives and lapping compounds	Bergwall: #501, "The Lathe Explained" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Nicholson: Shop Theory	Ohio: Machine Trades I, Bench Work Assignment Sheet #11
MP-12	Identifying and using files	Bergwall: #505-3, "Bench Metal Work" (FS); Prentice-Hall: #VD930-2, "Machine Shop: Bench Operations" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Nicholson: Shop Theory	Ohio: Machine Trades I, Bench Work Assignment Sheet #12
MP-13	Scraping flat and curved bearing surfaces	Bergwall: #505-1, "Bench Metal Work" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Nicholson: Shop Theory	Ohio: Machine Trades I, Bench Work Assignment Sheet #13
MP-14	Using hammers and screwdrivers for hand bench use	Bergwall: #505-6, "Bench Metal Work" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Nicholson: Shop Theory	Ohio: Machine Trades I, Bench Work Assignment Sheet #14
MP-15	Identifying and using wrenches	Bergwall: #505-6, "Bench Metal Work" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Nicholson: Shop Theory	Ohio: Machine Trades I, Bench Work Assignment Sheet #15

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Mechanical Processes

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
MP-16 Using bench vices and clamps		Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Nicholson: Shop Theory	Ohio: Machine Trades I, Bench Work Assignment Sheet #16
MP-17 Identifying and using chipping tools		Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Nicholson: Shop Theory	Ohio: Machine Trades I, Bench Work Assignment Sheet #17; Machine Shop Training Course, Vol. II
MP-18 Using hand taps, dies and hand reamers	Bergwall: #505-5, "Bench Metal Work" (FS); Prentice-Hall: #VD930-4, "Machine Shop: Bench Operations" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Nicholson: Shop Theory	Ohio: Machine Trades I, Bench Work Assignment Sheet #18
MP-19 Identifying power tool safety practices	Bergwall: #514, "Working With Power Tools and Machines" (FS)	U.S. Navy: Tools and Their Uses	Ohio: Machine Trades I, Bench Work Assignment Sheet #19
MP-20 Assembling and fitting	Bergwall: #505-6, "Bench Metal Work" (FS)	Burghardt: Machine Tool Operation, Part I; Colvin: American Machinists' Handbook; Nicholson: Shop Theory	Ohio: Machine Trades I, Bench Work Assignment Sheet #20; Machine Shop Training Course, Vol. I
MP-21 Identifying fasteners	Prentice-Hall: #XF1128-3, "Working with Nuts and Bolts" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Nicholson: Shop Theory	Ohio: Machine Trades I, Bench Work Assignment Sheet #21; Machine Shop Training Course, Vol. I

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Manufacturing Processes

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio Visuals	Textbooks	Student Materials
MP-22	Using thread, center, fillet and radius gages	Bergwall: #503, "Measuring Tools Explained" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Nicholson: Shop Theory	Ohio: Machine Trades I, Bench Work Assignment Sheet #22; Machine Shop Training Course, Vol. I
MP-23	Identifying lubricants and greases	Bergwall: #501, "The Lathe Explained" (FS)	Oberg: Machinery's Handbook	Ohio: Machine Trades I, Bench Work Assignment Sheet #23
MP-24	Performing machine maintenance	Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Oberg: Machinery's Handbook; Colvin: American Machinists' Handbook; Manufacturer's Service Manual	Ohio: Machine Trades I, Bench Work Assignment Sheet #24
MP-25	Identifying bench work safety	Bergwall: #514, "Metal Shop Safety" (FS)	Burghardt: Machine Tool Operation, Part I; Porter: Machine Operations and Setups; Nicholson: Shop Theory; Williams: Accident Prevention Manual for Shop Teachers; Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Bench Work Assignment Sheet #25
MP-26	Identifying parts and functions of the drilling machine	Prentice-Hall: #929-1, "Machine Shop: Drill Press" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Nicholson: Shop Theory	Ohio: Machine Trades I, Drilling Machine Work Assignment Sheet #1

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block:

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio Visuals	Textbooks	Student Materials
MP-27	Identifying safety practices and precautions when using the drilling machine	Prentice-Hall: #929-1, "Machine Shop: Drill Press" (FS)	Burghardt: Machine Tool Operation, Part I; Porter: Machine Operations and Setups; Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Drilling Machine Work Assignment Sheet #2
MP-28	Identifying work holding devices and setups	Prentice-Hall: #929-1, "Machine Shop: Drill Press" (FS)	Burghardt: Machine Tool Operation, Part I; Porter: Machine Operations and Setups; Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Drilling Machine Work Assignment Sheet #3
MP-29	Identifying and using drill bit holding devices	Prentice-Hall: #929-2, "Machine Shop: Drill Press" (FS)	Burghardt: Machine Tool Operation, Part I; Porter: Machine Operations and Setups; Nicholson: Shop Theory	Ohio: Machine Trades I, Drilling Machine Work Assignment Sheet #4
MP-30	Identifying drill bits		Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Nicholson: Shop Theory; Cleveland Twist Drill Company: Use and Care of Twist Drills	Ohio: Machine Trades I, Drilling Machine Work Assignment Sheet #5
MP-31	Identifying cutting feeds and speeds		Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Nicholson: Shop Theory; Cleveland Twist Drill Company: Use and Care of Twist Drills	Ohio: Machine Trades I, Drilling Machine Work Assignment Sheet #6

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Manufacturing Processes

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
MP-32 Identifying lathe safety	Bergwall: #514, "Metal Shop Safety" (FS)	Burghardt: Machine Tool Operation, Part I; Porter: Machine Operations and Setups; Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #1
MP-33 Identifying lathes	Bergwall: #501-1, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Nicholson: Shop Theory; Colvin: American Machinists' Handbook	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #1
MP-34 Identifying work holding devices	Bergwall: #501-2, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Nicholson: Shop Theory	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #3
MP-35 Identifying cutting tools	Bergwall: #501-3, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Nicholson: Shop Theory; Colvin: American Machinists' Handbook; South Bend Lathe Works: How to Run a Lathe	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #4 and 5; Machine Shop Training Course, Vol. I

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Manufacturing Processes

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
MP-36 Identifying measuring tools	Bergwall: #503, "Measuring Tools Explained" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Nicholson: Shop Theory; Colvin: American Machinists' Handbook; South Bend Lathe Works: How to Run a Lathe; U.S. Navy: Tools and Their Uses	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #6; Machine Shop Training Course, Vol. I
MP-37 Identifying lathe attachments	Bergwall: #501-3, "The Lathe Explained" (FS); Prentice Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Nicholson: Shop Theory; South Bend Lathe Works: How to Run a Lathe	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #7
MP-38 Calculating cutting feeds and speeds on the lathe	Bergwall: #501-2, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Slade: Mathematics for Technical and Vocational Schools; Oberg: Machinery's Handbook; Colvin: American Machinists' Handbook; South Bend Lathe Works: How to Run a Lathe	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #8; Machine Shop Training Course, Vol. I

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Manufacturing Processes

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
MP-39 Determining R.P.M.	Bergwall: #501-2, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Slade: Mathematics for Technical and Vocational Schools; Oberg: Machinery's Handbook; South Bend Lathe Works: How to Run a Lathe	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #9; Machine Shop Training Course, Vol. I
MP-40 Centering stock	Bergwall: #501-2, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Colvin: American Machinists' Handbook; South Bend Lathe Works: How to Run a Lathe	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #10; Machine Shop Training Course, Vol. I
MP-41 Identifying principles of facing	Bergwall: #501-4, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; South Bend Lathe Works: How to Run a Lathe	
MP-42 Identifying principles of straight turning and turning to shoulders	Bergwall: #501-4, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Oberg: Machinery's Handbook; Colvin: American Machinists' Handbook	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #12; Machine Shop Training Course, Vol. I

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Manufacturing Processes

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
MP-43 Identifying thread cutting devices	Bergwall: #501-6, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Oberg: Machinery's Handbook; Colvin: American Machinists' Handbook	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #25; Machine Shop Training Course, Vol. I
MP-44 Identifying the parts of a thread		Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Oberg: Machinery's Handbook; Colvin: American Machinists' Handbook.	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #26; Machine Shop Training Course, Vol. I
MP-45 Identifying American National thread standards		Slade: Mathematics for Technical and Vocational Schools; Oberg: Machinery's Handbook; Colvin: American Machinists' Handbook; Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #27; Machine Shop Training Course, Vol. I
MP-46 Computing American National thread form		Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Oberg: Machinery's Handbook; Colvin: American Machinists' Handbook; Slade: Mathematics for Technical and Vocational Schools	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #28; Machine Shop Training Course, Vol. I

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Manufacturing Processes

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio Visuals	Textbooks	Student Materials
MP-47	Computing sharp V-thread forms		Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Oberg: Machinery's Handbook; Colvin: American Machinists' Handbook; Slade: Mathematics for Technical and Vocational Schools	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #29; Machine Shop Training Course, Vol. I
MP-48	Identifying acme threads		Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #30; Machine Shop Training Course, Vol. I
MP-49	Identifying square threads		Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #32; Machine Shop Training Course, Vol. I
MP-50	Identifying classes of fits of screw threads		Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #33
MP-51	Using thread gages	Bergwall: #501-6, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #34

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Manufacturing Processes

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
MP-52 Using a thread micrometer	Bergwall: #501-6, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #35; Machine Shop Training Course, Vol. I
MP-53 Identifying turret lathes		Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Turret Lathe Work Assignment Sheet #1
MP-54 Identifying turret lathe safety practices		Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Turret Lathe Work Assignment Sheet #2
MP-55 Maintaining the turret lathe		Manufacturer's service or maintenance manual	Ohio: Machine Trades I, Turret Lathe Work Assignment Sheet #3
MP-56 Identifying workholding devices		Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Turret Lathe Work Assignment Sheet #4
MP-57 Identifying chucking operations on the turret lathe		Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Turret Lathe Work Assignment Sheet #5
MP-58 Selecting cutting speed and feed on the turret lathe		Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Turret Lathe Work Assignment Sheet #9
MP-59 Identifying coolants and cutting compounds		Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Turret Lathe Work Assignment Sheet #10

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Manufacturing Processes

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
MP-60 Identifying power cut-off saws		Burghardt: Machine Tool Operation, Part I; Porter: Machine Operations and Setups	Ohio: Machine Trades I, Power Saw Work Assignment Sheet #1
MP-61 Identifying power saw safety		Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Power Saw Work Assignment Sheet #2
MP-62 Identifying and using work holding devices on the power cut-off saw		Burghardt: Machine Tool Operation, Part I; Porter: Machine Operations and Setups; Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Power Saw Work Assignment Sheet #3
MP-63 Identifying, selecting and mounting saw blades		Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; Saw Blade Catalogs	Ohio: Machine Trades I, Power Saw Work Assignment Sheet #4
MP-64 Identifying speeds, feeds and coolants for power cut-off saws	Bergwall: #505-2, "Bench Metalwork" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Power Saw Work Assignment Sheet #6
MP-65 Using the power cut-off saw for straight and angular sawing	Bergwall: #505-2, "Bench Metalwork" (FS)	Burghardt: Machine Tool Operation, Part I; Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Power Saw Work Assignment Sheet #6

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Manufacturing Processes

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
MP-66 Identifying types, sizes, construction, specifications, nomenclature and range of work for shapers		Burghardt: Machine Tool Operation, Part II; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; McCarthy: Machine Tool Technology	Ohio: Machine Trades II, Shaper Assignment Sheets #2, 13 and 14
MP-67 Identifying shaper work holding devices and their functions		Burghardt: Machine Tool Operation, Part II; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; McCarthy: Machine Tool Technology	Ohio: Machine Trades II, Shaper Assignment Sheet #3
MP-68 Identifying shaper cutting tools, grinding them and attaching to machine		Burghardt: Machine Tool Operation, Part II; Porter: Machine Operations and Setups; McCarthy: Machine Tool Technology	Ohio: Machine Trades II, Shaper Assignment Sheet #4
MP-69 Setting up the shaper and calculating speed and feed		Burghardt: Machine Tool Operation, Part II; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; McCarthy: Machine Tool Technology	Ohio: Machine Trades II, Shaper Assignment Sheet #5
MP-70 Adjusting the shaper		Burghardt: Machine Tool Operation, Part II; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; McCarthy: Machine Tool Technology	Ohio: Machine Trades II, Shaper Assignment Sheet #6

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Manufacturing Processes

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
MP-71 Performing a horizontal shaping operation		Burghardt: Machine Tool Operation, Part II; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; McCarthy: Machine Tool Technology	Ohio: Machine Trades II, Shaper Assignment Sheet #7
MP-72 Performing a vertical shaping operation		Burghardt: Machine Tool Operation, Part II; Kibbe: Machine Tool Practices; Porter: Machine Operations and Setups; McCarthy: Machine Tool Technology	Ohio: Machine Trades II, Shaper Assignment Sheet #8
MP-73 Identifying types, sizes, construction, specifications, nomenclature and range of work for planers		Burghardt: Machine Tool Operation, Part II; Porter: Machine Operations and Setups	Ohio: Machine Trades II, Shaper Assignment Sheet #8
MP-74 Identifying and using work holding and clamping devices		Burghardt: Machine Tool Operation, Part II; Porter: Machine Operations and Setups; Kibbe: Machine Tool Practices; McCarthy: Machine Tool Technology	Ohio: Machine Trades II, Planer Work Assignment Sheet #4
MP-75 Identifying planer cutting tools, grinding them and attaching to machine		Burghardt: Machine Tool Operation, Part II; Porter: Machine Operations and Setups; Kibbe: Machine Tool Practices; McCarthy: Machine Tool Technology	Ohio: Machine Trades II, Planer Work Assignment Sheet #4

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Manufacturing Processes

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
MP-76 Setting up the planer and calculating speed and feed		Burghardt: Machine Tool Operation, Part II; Porter: Machine Operations and Setups; Kibbe: Machine Tool Practices; McCarthy: Machine Tool Technology	Ohio: Machine Trades II, Planer Work Assignment Sheet #6
MP-77 Performing planing operations		Burghardt: Machine Tool Operation, Part II; Porter: Machine Operations and Setups; Kibbe: Machine Tool Practices; McCarthy: Machine Tool Technology	Ohio: Machine Trades II, Planer Work Assignment Sheet #7
MP-78 Maintaining and caring for the planer		Burghardt: Machine Tool Operation, Part II; Porter: Machine Operations and Setups; Kibbe: Machine Tool Practices	Ohio: Machine Trades II, Planer Work Assignment Sheet #15
MP-79 Identifying types, sizes, construction, specifications, nomenclature and range of work for milling machines	Bergwall: #502-1, "Milling Machine Explained" (FS); Prentice-Hall: #VD919-1, "Machine Shop: Horizontal Milling Machine" (FS)	Burghardt: Machine Tool Operation, Part II; Porter: Machine Operations and Setups; Kibbe: Machine Tool Practices; McCarthy: Machine Tool Technology	Ohio: Machine Trades II, Milling Work Assignment Sheet #1, 8

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Manufacturing Processes

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio Visuals	Textbooks	Student Materials
MP-80	Identifying milling machine work holding devices and their functions	Bergwall: #502-2, "Milling Machine Explained" (FS); Prentice-Hall: #VD919-2, "Machine Shop: Horizontal Milling Machine" (FS); Prentice-Hall: #VD920-1, "Machine Shop: Vertical Milling Machine" (FS)	Burghardt: *Machine Tool Operation, Part II*; Porter: *Machine Operations and Set-ups*; Kibbe: *Machine Tool Practices*; Walker: *Machining Fundamentals*	Ohio: *Machine Trades II*, Milling Work Assignment Sheet #4
MP-81	Identifying, selecting and aligning milling machine attachments	Bergwall: #502-3, 4 and 5, "Milling Machine Explained" (FS); Prentice-Hall: #VD-919-5, "Machine Shop: Horizontal Milling Machine" (FS); Prentice-Hall: #VD920-4, "Machine Shop: Vertical Milling Machine" (FS)	Burghardt: *Machine Tool Operation, Part II*; Porter: *Machine Operations and Set-ups*; Kibbe: *Machine Tool Practices*; Walker: *Machining Fundamentals*	Ohio: *Machine Trades II*, Milling Work Assignment Sheet #5
MP-82	Selecting and setting up milling machine cutters and holders	Bergwall: #502-2, "Milling Machine Explained" (FS); Prentice-Hall: #XF919-2, "Machine Shop: Horizontal Milling Machine" (FS)	Burghardt: *Machine Tool Operation, Part II*; Porter: *Machine Operations and Set-ups*; Kibbe: *Machine Tool Practices*; Walker: *Machining Fundamentals*	Ohio: *Machine Trades II*, Milling Work Assignment Sheet #6
MP-83	Calculating cutting feeds and speeds for milling machine work	Prentice-Hall: #VD919-3, "Machine Shop: Horizontal Milling Machine" (FS)	Burghardt: *Machine Tool Operation, Part II*; Porter: *Machine Operations and Set-ups*; Kibbe: *Machine Tool Practices*; Walker: *Machining Fundamentals*	Ohio: *Machine Trades II*, Milling Work Assignment Sheet #6

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Manufacturing Processes

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
MP-84 Performing a plain milling operation	Bergwall: #502-4, "Milling Machine Explained" (FS); Prentice-Hall: #VD919-3, "Machine Shop: Horizontal Milling Machine" (FS); Prentice-Hall: #VD920-2, "Machine Shop: Vertical Milling Machine" (FS)	Burghardt: Machine Tool Operation, Part II; Porter: Machine Operations and Setups; Kibbe: Machine Tool Practices; Walker: Machining Fundamentals	Ohio: Machine Trades II, Milling Work Assignment Sheet #9
MP-85 Identifying types of gears and their functions		Burghardt: Machine Tool Operation, Part II; Kibbe: Machine Tool Practices	Ohio: Machine Trades II, Gear Assignment Sheet #1
MP-86 Identifying gear tooth elements and their symbols		Burghardt: Machine Tool Operation, Part II; Kibbe: Machine Tool Practices	Ohio: Machine Trades II, Gear Assignment Sheet #4
MP-87 Calculating the pitch, diameters, working depth and clearances for machining gears		Burghardt: Machine Tool Operation, Part II; Kibbe: Machine Tool Practices	Ohio: Machine Trades II, Gear Assignment Sheets #5, 6, 7 and 8
MP-88 Identifying grinders, grinding wheels and attachments		Burghardt: Machine Tool Operation, Part II; Kibbe: Machine Tool Practices	Ohio: Machine Trades II, Grinding Assignment Sheets #1-12
MP-89 Using the bench grinder		Walker: Machining Fundamentals	Ohio: Machine Trades II, Bench Grinder Assignment Sheets #1-4
MP-90 Identifying materials used in sheet metalwork	Bergwall: #507, "Sheet Metalwork: Introduction and Overview" (FS)	Johnson: Technical Metals; Feirer: Metalwork	

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Manufacturing Processes

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
MP-91 Developing sheet metal patterns	Bergwall: #507, "Straight Line Pattern Development" (FS); Bergwall: #507, "Parallel and Radial Line Pattern Development" (FS)	Johnson: Technical Metals; Feirer: Metalwork	
MP-92 Cutting sheet metal	Prentice-Hall: #VD934, "Cutting Sheet Metal" (FS); Bergwall: #507, "Cutting Methods" (FS)	Johnson: Technical Metals; Feirer: Metalwork	
MP-93 Bending sheet metal by hand	Bergwall: #507, "Forming and Bending, Part 2" (FS)	Johnson: Technical Metals; Feirer: Metalwork	
MP-94 Bending metal on a bar folder or brake	Bergwall: #507, "Drilling, Forming and Bending, Part 1" (FS)	Johnson: Technical Metals; Feirer: Metalwork	
MP-95 Roll-forming sheet metal		Johnson: Technical Metals; Feirer: Metalwork	
MP-96 Making seams	Prentice-Hall: #VD934, "Seams and Joints" (FS); Bergwall: #507, "Assembly and Fastening" (FS)	Johnson: Technical Metals; Feirer: Metalwork	
MP-97 Using the rotary machine		Johnson: Technical Metals; Feirer: Metalwork	
MP-98 Fastening sheet metal	Bergwall: #507, "Assembly and Fastening" (FS); Prentice-Hall: #VD934, "Riveting and Fastening" (FS)	Johnson: Technical Metals; Feirer: Metalwork	

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Manufacturing Practices

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio Visuals	Textbooks	Student Materials
MP-99	Soft soldering sheet metal	Prentice-Hall: #VD934, "Soldering" (FS); Bergwall: #507, "Assembly and Fastening" (FS)	Johnson: Technical Metals; Feirer: Metalwork	

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Mechanics and Design

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
MD-01 Transforming units		Zebrowski: Physics for Technicians; Marcus and Thrower: Applied Physics	
MD-02 Calculating resultant force		Zebrowski: Physics for Technicians; Marcus and Thrower: Applied Physics; Levinson: Statics and Strength of Materials	
MD-03 Calculating forces in static systems		Zebrowski: Physics for Technicians; Levinson: Statics and Strength of Materials; Bassin: Statics and Strength of Materials	
MD-04 Calculating stress		Zebrowski: Physics for Technicians; Levinson: Statics and Strength of Materials	
MD-05 Calculating strain		Zebrowski: Physics for Technicians; Levinson: Statics and Strength of Materials	
MD-06 Calculating deformation		Zebrowski: Physics for Technicians; Levinson: Statics and Strength of Materials	
MD-07 Calculating restoring force		Zebrowski: Physics for Technicians; Levinson: Statics and Strength of Materials	
MD-08 Designing area of materials under stress		Zebrowski: Physics for Technicians; Levinson: Statics and Strength of Materials	

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Mechanics and Design

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
MD-09 Calculating frictional forces		Zebrowski: Physics for Technicians; Marcus and Thrower: Applied Physics; Pollack: Applied Physics; Olivo and Wayne: Fundamentals of Applied Physics	
MD-10 Calculating mass		Zebrowski: Physics for Technicians; Marcus and Thrower: Applied Physics; Pollack: Applied Physics; Harris and Hemmerling: Introductory Applied Physics	
MD-11 Describing motion in one dimension		Zebrowski: Physics for Technicians; Harris and Hemmerling: Introductory Applied Physics; Pollack: Applied Physics; Marcus and Thrower: Applied Physics	
MD-12 Describing motion resulting from forces		Zebrowski: Physics for Technicians; Harris and Hemmerling: Introductory Applied Physics; Pollack: Applied Physics; Marcus and Thrower: Applied Physics	
MD-13 Describing motion resulting from torques		Zebrowski: Physics for Technicians; Harris and Hemmerling: Introductory Applied Physics; Pollack: Applied Physics; Marcus and Thrower: Applied Physics	

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Mechanics and Design

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
MD-14 Describing motion using momentum principles		Zebrowski: *Physics for Technicians*; Harris and Hemmerling: *Introductory Applied Physics*; Pollack: *Applied Physics*; Marcus and Thrower: *Applied Physics*	
MD-15 Describing motion using energy principles		Zebrowski: *Physics for Technicians*; Harris and Hemmerling: *Introductory Applied Physics*; Pollack: *Applied Physics*; Marcus and Thrower: *Applied Physics*	
MD-16 Calculating work		Zebrowski: *Physics for Technicians*; Harris and Hemmerling: *Introductory Applied Physics*; Pollack: *Applied Physics*; Marcus and Thrower: *Applied Physics*	
MD-17 Calculating power		Zebrowski: *Physics for Technicians*; Harris and Hemmerling: *Introductory Applied Physics*; Pollack: *Applied Physics*; Marcus and Thrower: *Applied Physics*	
MD-18 Calculating efficiency		Zebrowski: *Physics for Technicians*; Harris and Hemmerling: *Introductory Applied Physics*; Pollack: *Applied Physics*; Marcus and Thrower: *Applied Physics*	

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Fluid Power

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
FP-01 Identifying principles of hydraulics	Howard W. Sams and Co.: #20592, "Fluid Power" (TR)	Pease: Basic Fluid Power; ABC's of Hydraulic Circuits; Pippenger and Hicks: Industrial Hydraulics; Delmar: Electromechanical Technology Series, Fluids	Plant Engineering Training Systems: Basic Hydraulics, Lesson One; Oregon: IM-HY-02, ILS
FP-02 Identifying hydraulic fluids		Pease: Basic Fluid Power; Pippenger and Hicks: Industrial Hydraulics; Delmar: Electromechanical Technology Series, Fluids	Plant Engineering Training Systems: Basic Hydraulics, Lesson Two
FP-03 Identifying strainers and filters in hydraulic systems		Pease: Basic Fluid Power; Pippenger and Hicks: Industrial Hydraulics; Delmar: Electromechanical Technology Series, Fluids	Plant Engineering Training Systems: Basic Hydraulics, Lesson Three
FP-04 Identifying reservoirs and accumulators in a hydraulic system		Pease: Basic Fluid Power; Pippenger and Hicks: Industrial Hydraulics; Delmar: Electromechanical Technology Series, Fluids	Plant Engineering Training Systems: Basic Hydraulics, Lesson Four; Oregon: Reservoirs
FP-05 Identifying hydraulic pumps on a system		Pease: Basic Fluid Power; Pippenger and Hicks: Industrial Hydraulics; Delmar: Electromechanical Techology Series, Fluids	Plant Engineering Training Systems: Basic Hydraulics, Lesson Five; Oregon: Pumps

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Fluid Power

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
FP-06 Identifying piping, tubing and fittings		Pease: Basic Fluid Power; Pippenger and Hicks: Industrial Hydraulics; Delmar: Electromechanical Technology Series, Fluids	Plant Engineering Training Systems: Basic Hydraulics, Lesson Six
FP-07 Identifying directional control valves		Pease: Basic Fluid Power; Pippenger and Hicks: Industrial Hydraulics; Delmar: Electromechanical Technology Series, Fluids	Plant Engineering Training Systems: Basic Hydraulics, Lesson Seven; Oregon: Directional Control Valve
FP-08 Identifying pressure control valves		Pease: Basic Fluid Power; Pippenger and Hicks: Industrial Hydraulics; Delmar: Electromechanical Technology Series, Fluids	Plant Engineering Training Systems: Basic Hydraulics, Lesson Eight
FP-09 Identifying cylinders in a hydraulic system		Pease: Basic Fluid Power; Pippenger and Hicks: Industrial Hydraulics; Delmar: Electromechanical Technology Series, Fluids	Plant Engineering Training Systems: Basic Hydraulics, Lesson Nine; Oregon: Cylinders
FP-10 Identifying hydraulic motors		Pease: Basic Fluid Power; Pippenger and Hicks: Industrial Hydraulics; Delmar: Electromechanical Technology Series, Fluids	Plant Engineering Training Systems: Basic Hydraulics, Lesson Ten
FP-11 Identifying pneumatic principles	Bobbs-Merrill: #97228, "Fluid Power" (TR)	Pease: Basic Fluid Power; Stewart and Storer: Fluid Power	Plant Engineering Training Systems: Basic Pneumatics; Bobbs-Merrill: Fluid Power

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Fluid Power

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
FP-12 Identifying reciprocating compressors	Bobbs-Merrill: #97228, "Fluid Power" (TR)	Pease: Basic Fluid Power; Stewart and Storer: Fluid Power	Plant Engineering Training Systems: Basic Pneumatics, Lesson Two; Bobbs-Merrill: Fluid Power
FP-13 Identifying rotary compressors	Bobbs-Merrill: #97228, "Fluid Power" (TR)	Pease: Basic Fluid Power; Stewart and Storer: Fluid Power	Plant Engineering Training Systems: Basic Pneumatics, Lesson Three; Bobbs-Merrill: Fluid Power
FP-14 Identifying primary air treatment in pneumatic systems	Bobbs-Merrill: #97228, "Fluid Power" (TR)	Pease: Basic Fluid Power; Stewart and Storer: Fluid Power	Plant Engineering Training Systems: Basic Pneumatics, Lesson Four; Bobbs-Merrill: Fluid Power
FP-15 Identifying secondary air treatment methods	Bobbs-Merrill: #97228, "Fluid Power" (TR)	Pease: Basic Fluid Power; Stewart and Storer: Fluid Power	Plant Engineering Training Systems: Basic Pneumatics, Lesson Five; Bobbs-Merrill: Fluid Power
FP-16 Identifying piping, hoses and fittings used in pneumatic systems	Bobbs-Merrill: #97228, "Fluid Power" (TR)	Pease: Basic Fluid Power; Stewart and Storer: Fluid Power	Plant Engineering Training Systems: Basic Pneumatics, Lesson Six; Bobbs-Merrill: Fluid Power
FP-17 Identifying control valves	Bobbs-Merrill: #97228, "Fluid Power" (TR)	Pease: Basic Fluid Power; Stewart and Storer: Fluid Power	Plant Engineering Training Systems: Basic Pneumatics, Lesson Seven; Bobbs-Merrill: Fluid Power
FP-18 Identifying pressure relief valves	Bobbs-Merrill: #97228, "Fluid Power" (TR)	Pease: Basic Fluid Power; Stewart and Storer: Fluid Power	Plant Engineering Training Systems: Basic Pneumatics, Lesson Eight

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Fluid Power

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
FP-19 Identifying cylinders	Bobbs-Merrill: #97228, "Fluid Power" (TR)	Pease: Basic Fluid Power; Stewart and Storer: Fluid Power	Plant Engineering Training Systems: Basic Pneumatics, Lesson Nine
FP-20 Identifying motors	Bobbs-Merrill: #97228, "Fluid Power" (TR)	Pease: Basic Fluid Power; Stewart and Storer: Fluid Power	Plant Engineering Training Systems: Basic Pneumatics, Lesson Ten; Bobbs-Merrill: Fluid Power

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Electricity

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
EL-01 Defining terminology and analyzing theory associated with basic D.C. circuits	Audio Active: #91294, "Basic Electricity Program" (T); Bergwall: #801, "Basic Electricity and Electronics Explained - Direct Current" (FS)	Zebrowski: Physics for Technicians; Snow: Electrical Drafting and Design	McGraw-Hill: Basic Electricity
EL-02 Defining and converting electrical units associated with basic D.C. and A.C. circuits	Audio Active: #91294, "Basic Electricity Program" (T)	Tandy Corp.: Electronics Databook; Grob: Electrical Principles for Electronics	
EL-03 Calculating basic D.C. series circuits	Bergwall: #801, "Basic D.C." (FS); Audio-Active: #91294, "Basic Electricity Program" (T)	Snow: Electrical Drafting and Design	ESP, Inc.: #91294, Basic Electricity Program
EL-04 Calculating basic D.C. parallel circuits	Audio Active: #91294, "Basic Electricity Program" (T); Bergwall: #801, "Basic Electricity and Electronics Explained - Direct Current" (FS)	Grob: Electrical Principles for Electronics	McGraw-Hill: Basic Electricity; ESP, Inc.: #91294, Basic Electricity Program
EL-05 Calculating basic D.C. series parallel circuits	Audio Active: #91294, "Basic Electricity Program" (T); Bergwall: #801, "Basic Electricity and Electronics Explained - Direct Current" (FS)	Grob: Electrical Principles for Electronics	McGraw-Hill: Basic Electricity; Audio Active: #91294, Basic Electricity Program

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Electricity

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
EL-06 Defining terminology and analyzing theory associated with basic A.C. circuits	Audio Active: #91294, "Basic Electricity Program" (T); Bergwall: #802, "Basic Electricity and Electronics Explained - Alternating Current" (FS)	Zebrowski: Physics for Technicians; Grob: Electrical Principles for Electronics	
EL-07 Calculating power factors, impedance and pure resistance in series A.C. circuits	Audio Active: #91294, "Basic Electricity Program" (T); Bergwall: #802, "Basic Electricity and Electronics Explained - Alternating Current" (FS)	Grob: Electrical Principles for Electronics	Audio Active: #91294, Basic Electricity Program
EL-08 Calculating basic series A.C. circuits with inductance, reactance and resistance	Audio Active: #91294, "Basic Electricity Program" (T); Bergwall: #802, "Basic Electricity and Electronics Explained - Alternating Current" (FS)	Grob: Electrical Principles for Electronics	Audio Active: #91294, Basic Electricity Program
EL-09 Calculating basic A.C. circuits with capacitive reactance and resistance	Audio Active: #91294, "Basic Electricity Program" (T); Bergwall: #802, "Basic Electricity and Electronics Explained - Alternating Current" (FS)	Grob: Electrical Principles for Electronics	Audio Active: #91294, Basic Electricity Program
EL-10 Calculating series A.C. circuits with capacitive and inductive reactance and resistance	Bergwall: #802, "Basic Electricity and Electronics Explained - Alternating Current" (FS); Audio Active: #91294, "Basic Electricity Program" (T)	Grob: Electrical Principles for Electronics	Audio Active: #91294, Basic Electricity Program

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Electricity

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
EL-11 Calculating basic impedance in parallel A.C. circuits	Bergwall: #802, "Basic Electricity and Electronics Explained - Alternating Current" (FS); Audio Active: #91294, "Basic Electricity Program" (T)	Grob: *Electrical Principles for Electronics*	Audio Active: #91294, *Basic Electricity Program*
EL-12 Applying basic A.C. circuit theory when drawing residential cable layouts from engineering sketches	Bergwall: #803, "Electrical House Wiring Explained" (FS); DCA: "Residential Electrical Wiring" (TR)	Mullin: *Electrical Wiring - Residential*; Snow: *Electrical Drafting and Design*	
EL-13 Applying basic A.C. circuit theory when drawing commercial cable layouts from engineering sketches		Mullin and Smith: *Electrical Wiring Commercial*	
EL-14 Drawing electrical one-line diagrams from engineering sketches		Snow: *Electrical Drafting and Design*	
EL-15 Drawing electrical elementary diagrams from engineering sketches		Snow: *Electrical Drafting and Design*	
EL-16 Drawing electronic schematic diagrams from engineering sketches		Lindsey: *The Design and Drafting of Printed Circuit Boards*	

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Electricity

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
EL-17 Laying out, taping up and/or drawing basic printed circuit boards		Lindsey: The Design and Drafting of Printed Circuit Boards	
EL-18 Planning and performing site work for a small industrial facility	Bergwall: #804A, "Planning and Roughing In" (FS)	Croft: American Electrician's Handbook; Graham: Industrial and Commercial Wiring; Summers: National Electrical Code	
EL-19 Making calculations for motors, welders and heaters	Hobar: #471, "Electric Motors: Enclosures, Bearings and Mounting Methods" (ST)	Summers: National Electrical Code	
EL-20 Selecting the correct transformer bank		Manufacturer's catalog; Summers: National Electrical Code	
EL-21 Operating a split phase motor	AAVIM: #AV300, "How Electric Motors Start and Run" (ST)	Veinott: Fractional and Subfractional Horsepower Electric Motors; Rosenberg: Electric Motor Repair; Croft: American Electrician's Handbook	Hampden Manual; Georgia: Industrial Electricity, Industrial Wiring, Unit IW-20
EL-22 Operating a capacitor start motor	AAVIM: #AC300, "How Electric Motors Start and Run" (ST)	Veinott: Fractional and Subfractional Horsepower Electric Motors; Rosenberg: Electric Motor Repair; Croft: American Electrician's Handbook	Hampden Manual; Georgia: Industrial Electricity, Industrial Wiring, Unit IW-22

CURRICULUM AREA: MECHANICAL TECHNOLOGY
Major Block: Electricity

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio Visuals	Textbooks	Student Materials
EL-23	Operating a universal motor	AAVIM: #AV300, "How Electric Motors Start and Run" (ST)	Veinott: Fractional and Subfractional Horsepower Electric Motors; Rosenberg: Electric Motor Repair; Adams: Electrical Principles and Practices	Georgia: Industrial Electricity, Industrial Wiring, Unit IW-25
EL-24	Operating an induction regulator			Standard Electric Time Bulletin; Georgia: Industrial Electricity, Industrial Wiring, Unit IW-41
EL-25	Operating a rotary frequency changer		Croft: American Electrician's Handbook	Standard Electric Time Bulletin; Georgia: Industrial Electricity, Industrial Wiring, Unit IW-42
EL-26	Operating a rotary converter	Bergwall: #810, "Rotary Machinery Explained - Direct Current Motors" (FS)		Standard Electric Time Bulletin; Georgia: Industrial Electricity, Industrial Wiring, Unit IW-44

TEXTBOOK LIST

ABC's of Hydraulic Circuits. Indianapolis, IN: Howard W. Sams & Company Inc., 1980.

Adams, V. E., Electrical Principles and Practices. New York, NY: McGraw-Hill Book Company, 1973.

Bassin, Milton G., et al., Statics and Strength of Materials, McGraw-Hill Book Company, 1969.

Burghardt, H. D., Axelrod, A. and Anderson, James, Machine Tool Operation (Part I). New York, NY: Gregg/McGraw-Hill Company, Inc., 1959.

Burghardt, H. D., Axelrod, A. and Anderson, James, Machine Tool Operation (Part II). New York, NY: Gregg/McGraw-Hill Company, Inc., 1960.

Croft, T., et al., American Electrician's Handbook (9th ed.). New York, NY: McGraw-Hill Book Company, 1970.

Electromechanical Technology Series. Albany, NY: Delmar Publishers, 1971.

Feirer, John L., Metalwork. Peoria, IL: Bennett Company, 1970.

Gilli, Angelo C., Electrical Principles for Electronics (3rd ed.). McGraw-Hill Book Company, 1978.

Graham, K. C., Industrial and Commercial Wiring (2nd ed.). Chicago, IL: American Technical Society, 1963.

Grob, Bernard, Basic Electronics (4th ed.). McGraw-Hill Book Company, 1977.

Harris, Norman, C. and Hemmerling, Edwin M., Introductory Applied Physics (3rd ed.). New York, NY: McGraw-Hill Book Company, 1978.

Johnson, Harold V., Technical Metals, Peoria, IL: Bennett Company, 1973.

Kibbe, R. R., Neely, J. E., Meyer, R. O. and White, W. T., Machine Tool Practices. New York, NY: John Wiley and Sons, 1979.

Levison, Irving V., Statics and Strength of Materials. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1970.

Lindsey, Darryl, The Design and Drafting of Printed Circuit Boards. Bishop Graphics, Inc.

Marcus and Thrower, Applied Physics. Briton Publishers.

Maintenance Engineering Handbook (2nd ed.). New York, NY: McGraw-Hill Book Company, 1978.

McCarthy, W. J. and Repp, V. E., Machine Tool Technology. Bloomington, IL: McKnight and McKnight Publishing Company, 1979.

Mullin, Ray C. and Smith, Robert L., Electrical Wiring-Commercial. Albany, NY: Delmar Publishers, 1977.

Mullin, Ray C., Electrical Wiring-Residential. Albany, NY: Delmar Publishers, 1977.

Oberg, Erik and Jones, F. D., Machinery's Handbook. New York, NY: Industrial Press, Inc., 1976.

Olivo, C. T., Basic Machine Technology (Instructor's Guide). Indianapolis, IL: Bobbs-Merrill Educational Publishing, 1980.

Olivo, C. T., Basic Machine Technology (Text). Indianapolis, IN: Bobbs-Merrill Educational Publishing, 1980.

Olivo and Wayne, Fundamentals of Applied Physics. Albany, NY: Delmar Publishers, 1975.

Ohio, Machine Trade I (Instructor's Manual, 3rd ed.). Columbus, OH: Instructional Materials Laboratory, 1971.

Ohio, Machine Trade II (Instructor's Manual, 3rd ed.). Columbus, OH: Instructional Materials Laboratory, 1971.

Pease, Dudley A., Basic Fluid Power. Englewood Cliffs, NY: Prentice-Hall, Inc., 1967.

Pippenger, John J. and Hicks, Tyler G., Industrial Hydraulics. New York, NY: McGraw-Hill Book Company, 1970.

Pollack, Hermann W., Applied Physics. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1971.

Porter, H. W., Lascoe, O. D. and Nelson, C. A., Machine Shop Operations and Setups. Chicago, IL: American Technical Society, 1973.

Raskhodoff, N. M., Electronic Drafting and Design (3rd ed.). Englewood Cliffs, NJ: Prentice-Hall, Inc., 1977.

Rosenberg, K., Electric Motor Repair (2nd ed.). New York, NY: Holt, Rinehart and Winston.

Snow, C. W., Electrical Drafting and Design. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Stewart, Harry, L. and Storer, John M., Fluid Power. Indianapolis, IN: Bobbs-Merrill Publishing Company, 1980.

Shiers, George, Electronic Drafting. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1962.

Summers, W., National Electrical Code. Boston, MA: National Fire Protection Association.

U.S. Navy, Tools and Their Uses. New York, NY: Dover Publications, Inc., 1973.

Walker, John R., Machining Fundamentals. South Holland, IL: The Goodheart-Willcox Company, Inc., 1973.

Veinott, C., Fractional and Subfractional - Horsepower Electric Motors (3rd ed.). New York, NY: McGraw-Hill Book Company.

Zebrowski, Ernest, Jr., Physics for Technicians, New York, NY: McGraw-Hill Book Company.

STUDENT MANUALS

Georgia, Industrial Electricity: Industrial Wiring, Student Manual. Atlanta, GA: Georgia Department of Education, 1976.

Georgia, Industrial Maintenance Training Program. Plant Engineering Training Systems, 1971.

Gerevas, Drafting Technology Problems. Indianapolis, IN: Bobbs-Merrill Publishing Company.

Hampden Manual. East Longmeadow, MA: Hampden Engineering Corporation.

Hawk, Minor C., Descriptive Geometry, McGraw-Hill Book Company.

Jones, F. D., Machine Shop Training Course, Volume I. New York, NY: Industrial Press, Inc., 1964.

Jones, F. D., Machine Shop Training Course, Volume II. New York, NY: Industrial Press, Inc., 1964.

Ohio, Machine Trades I (Learner's Manual, 3rd ed.). Columbus, OH: Instructional Materials Laboratory, The Ohio State University, 1971.

Ohio, Machine Trades II (Learner's Manual, 3rd ed.). Columbus, OH: Instructional Materials Laboratory, The Ohio State University, 1971.

AUDIO VISUALS

AAVIM	Slide/tapes
Bergwall Productions, Inc.	Filmstrips
Career Aids, Inc.	Filmstrips
DCA Educational Products	Transparencies/8mm loops
ESP, Inc.	Audio tapes
Georgia Department of Education	Slide/tapes
Prentice-Hall Media	Filmstrips

ADDITIONAL INSTRUCTIONAL RESOURCES

Textbooks

Alerich, W., *Electricity 4-AC Motors and Generators, Controls, Alternators* (3rd ed.). Albany, NY: Delmar Publishers, 1980.

Alerich, W., *Electricity 3-DC Motors and Generators, Controls, Transformers* (3rd ed.). Albany, NY: Delmar Publishers, 1980.

Anderson, E. P. and Miller, R., *Electric Motors* (3rd ed.). Indianapolis, IN: Bobbs-Merrill Educational Publishing Company, 1977.

Bell, D., *Fundamentals of Electric Circuits* (2nd ed.). Reston, VA: Reston Publishing Company, 1981.

Brenemann, John W., *Strength of Materials* (3rd ed.). Albany, NY: McGraw-Hill Book Company, 1965.

Busch and Wilkie Bros. Foundation, *Fundamentals of Dimensional Metrology*. Albany, NY: Delmar Publishers, 1966.

Chapin, Jack W., *Metal Manufacturing Technology*. Bloomington, IL: McKnight Publishing Company, 1976.

Dickenson, Harry and Kleinschmidt, Robert, *Technical Metals*. Albany, NY: McGraw-Hill Book Company, 1974.

Gebert, Kenneth C., *National Electrical Code Blueprint Reading*. Peoria, IL: American Technical Society, 1974.

Graham, Kenneth C., *Industrial and Commercial Wiring* (2nd ed.). Peoria, IL: American Technical Society, 1963.

Hoffman, Edward G., *Jig and Fixture Design*. Albany, NY: Delmar Publishers, 1980.

Johnson, Olaf A., *Fluid Power: Pneumatics*. Chicago, IL: American Technical Society, 1975.

Larkin, John C., *Practical Problems in Mathematics for Drafting*. Albany, NY: Delmar Publishers, 1979.

Lightle, R. Paul, *Blueprint Reading and Sketching*. Bloomington, IL: McKnight Publishing Company, 1965.

Lister, E., *Electrical Circuits and Machines* (5th ed.). Boston, MA: McGraw-Hill Book Company, 1968.

Loper, O., *Direct Current Fundamentals* (2nd ed.). Albany, NY: Delmar Publishers, 1978.

McDonnell, L. P. and Kaumehewia, A. I., The Use of Hardworking Tools. Albany, NY: Delmar Publishers, 1962.

McDonnell, L. P. and Kaumehewia, A. I., The Use of Portable Power Tools. Albany, NY: Delmar Publishers, 1962.

Middleton, R., Practical Electricity (3rd ed.). Indianapolis, IN: Bobbs-Merrill Educational Publishing, 1969.

Miller, R., Industrial Electricity. Peoria, IL: Bennett Publishing Company, 1981.

Mullin, R. and Smith, R., Electrical Wiring-Commercial. Albany, NY: Delmar Publishers, 1978.

Nelson, John, Drafting for Trades and Industry-Mechanical and Electronic. Albany, NY: Delmar Publishers, 1979.

Palmquist, R. E., House Wiring (4th ed.). Indianapolis, IN: Bobbs-Merrill Educational Publishing, 1978.

Patrick, D. R. and Fardo, S. W., Industrial Electrical Systems, Indianapolis, IN: Bobbs-Merrill Educational Publishing, 1978.

Singer, B., Basic Mathematics for Electricity and Electronics (4th ed.). Boston, MA: McGraw-Hill Book Company, 1978.

Siskind, C., DC and AC Electrical Machines (2nd ed.). Boston, MA: McGraw-Hill Book Company, 1959.

Solaman, R. A., Dictionary of Tools. Peoria, IL: Bennett Publishing Company.

Steinberg, W. and Ford, W., Basic Electricity and Electronics (4th ed.). Chicago, IL: American Technical Society, 1972.

Traister, J. E., Electrical Blueprint Reading. Indianapolis, IN: Bobbs-Merrill Educational Publishing, 1975.

ADDITIONAL INSTRUCTIONAL RESOURCES

Student Manuals

Electromechanical Technology Series, Delmar Publishers.

INTRODUCTORY MANUALS
Motor Controls
Devices
Amplifiers
Electricity
Drives
Linkages
Fluids
Optics

ADVANCED MANUALS
Automatic Controls
Servo-Mechanisms
Fabrication
Transducers
Communication
Digital
Machines
Materials

Kibbe, R. R., et al., Machine Tool Practices. Somerset, NJ: John Wiley and Sons.

Loper, O. B. and Ahr, P. F., Electricity and Electronics Research and Development Manual. Albany, NY: Delmar Publishers.

Oregon Board of Education, Mechanics. Oregon Board of Education.

Related Information Electricity 1. Albany, NY: Delmar Publishers.

Audio Visuals

A.J. Nystrom and Co.	Transparencies
Animated Electronic Films	Super 8mm loop
Association Films, Inc.	16mm reel
Bailey-Film Associates	Super 8mm loop
CCM School Materials, Inc.	Transparencies
CENCO Educational Aids	8mm loop/transparencies
Coronet Films	16mm reel
Creative Visuals	Transparencies
Curriculum Materials Corp.	Filmstrips
DCA Educational Products, Inc.	Transparencies
Educational Britannica Educational Corp.	16mm reel
Eye Gate House, Inc.	Transparencies
GAF Corporation Reprographic Products	Transparencies
George F. Cram Company, Inc.	Transparencies
Hank Newenhouse/Novo	16mm reel
Indiana University Audio Visual Center	16mm reel
Jam Handy School Service, Inc.	Filmstrips/super 8mm loop
Long Filmslide Service	Filmstrips
McGraw-Hill Films	Filmstrips/transparencies
NASCO	Filmstrips/transparencies
Popular Science Publishing Co.	Filmstrips/transparencies
Rand McNally and Co.	8mm loop
Schoolmasters Science	8mm loop
Serina Press	16mm reel

Society for Visual Education, Inc.	Filmstrips
Stansi Scientific Division	Transparencies
Sterling Educational Films	8mm loop
3 M Company	Transparencies
Tweedy Transparencies	Transparencies
United States National Audio Visual Center	16mm reel
United Transparencies, Inc.	Transparencies
Universal Education and Visual Arts	16mm reel

RESOURCE ADDRESSES

A. J. Nystrom and Company
3333 Elston Avenue
Chicago, IL 60618

AAVIM (American Association
for Vocational Instructional Materials)
120 Engineering Center
Athens, GA 30602

American Technical Society
848 E. 58th Street
Chicago, IL 60637

Animated Electronic Films
P.O. Box 2036
Eads Station
Arlington, VA 22202

Association Films, Inc.
600 Madison Avenue
New York, NY 10022

Bailey Film Associates
11559 Santa Monica Blvd.
West Los Angeles, CA 90025

Bennett Publishing Company
809 W. Detweiller Dr.
Dept. E 81
Peoria, IL 61615

Bergwall Productions, Inc.
839 Stewart Avenue
Garden City, NY 11530

Bobbs-Merrill Educational
Publishing
4300 West 62nd Street
P.O. Box 7080
Indianapolis, IN 46206
(317) 298-5745

Career Aids, Inc.
8950 Lurline Avenue
Dept. T 76
Chatsworth, CA 91311
(213) 341-8200

CCM School Materials, Inc.
2124 West 82nd Place
Chicago, Il 60620

CENCO Educational Aids
2600 S. Kostner Avenue
Chicago, IL 60623

Continuing Education
Publications
P.O. Box 1394
Portland, OR 97207

Coronet Films
65 E. South Water Street
Chicago, IL 60601

Creative Visuals
Box 1911
Big Spring, TX 79720

Curriculum Materials Corporation
1319 Vine Street
Philadelphia, PA 19109

DCA Educational Products, Inc.
4865 Stanton Avenue
Philadelphia, PA 19144

Delmar Publishers
P.O. Box 5087
Albany, NY 12205
(800) 325-6000

Dover Publications
180 Varick St.
New York, NY 10014

Duxbury Press
A Division of Wadsworth
Publishing Company, Inc.
Belmont, CA 94002

Educational Methods
Division of Development Systems
Corp.
Chicago, IL

Encyclopedia Britannica Corporation
405 North Michigan Avenue
Chicago, IL 60611

Eye Gate House, Inc.
146-01 Archer Avenue
Jamaica, NY 11435

GAF Corporation Reprographic
Products
140 West 51st Street
New York, NY 10020

George F. Cram Company, Inc.
School and Library Division
P.C. Box 426
Indianapolis, IN 46026

The Goodheart-Willcox Company
123 W. Taft Drive
South Holland, IL 60473

Hampden Engineering Corporation
Shaker Road
East Longmeadow, MA 01028

Henk Newenhouse/Novo
1825 Willow Road
Northfield, IL 60093

Hobar Publications
1234 Tiller Lane
St. Paul, MN 55112
(612) 633-3170

Holt, Rinehart and Winston
383 Madison Avenue
New York, NY 10017

Indiana University Audio
Visual Center
Field Services Department
Bloomington, IL 47401

Jam Handy School Service, Inc.
2781 East Grand Blvd.
Detroit, MI 48211

John Wiley and Sons, Inc.
Eastern Distribution Center
1 Wiley Drive
Somerset, NJ 08873
(201) 469-4400

Long Filmslide Service
7505 Fairmont Avenue
El Cerrito, CA 94530

McGraw-Hill Book Company
607 Boylston Street
Boston, MA 02116

McGraw-Hill Films
8171 Redwood Hwy.
Novato, CA 94947

NASCO
Fort Atkinson, WI 53538

National Fire Protection Association
470 Atlantic Avenue
Boston, MA 02110

Nooger and Neville, Inc.
15 Maiden Lane
New York, NY 10038

Popular Science Publishing
Company
Audio Visual Division
355 Lexington Avenue
New York, NY 10017

Rand-McNally and Company
405 Park Avenue
New York, NY 10022

Reston Publishing Company
11480 Sunset Hills Road
Reston, VA 22090

Schoolmasters Science
745 State Circle
Ann Arbor, MI 48104

Serina Press
70 Kennedy Street
Alexandria, VA 22305

Singer Career Systems
80 Commerce Drive
Rochester, NY 14623
(800) 828-7876

Society for Visual Education,
Inc.
1345 Diversey Parkway
Chicago, IL 60614

Square D Company
Executive Plaza
Palatine, FL 60067

Standard Electric Time Company
89 Logan Street
Springfield, MA 01101

Stansi Scientific Division
1231 North Honore Street
Chicago, IL 60622

Sterling Educational Films
241 East 34th Street
New York, NY 10016

3M Company
Visual Products Division
St. Paul, MN 55101

Tweedy Transparencies
208 Hollywood Avenue
East Orange, NJ 07018

United States National Audiovisual Center
National Archives and Records Service
Washington, DC 20409

United Transparencies, Inc.
P.O. Box 688
Binghamton, NY 13902

Universal Education and Visual Arts
221 Park Avenue South
New York, NY 10003

Vocational Education Materials Center
University of Georgia
Green Street
Athens, GA 30602

Westinghouse Learning Corporation
100 Park Avenue
New York, NY 10017

SECTION VII

STUDENT RECORDS

STUDENT RECORDS

This section contains four forms, the Individual Progress Report Chart, the Group Progress Chart, the Competency Checklist and the Certificate of Competency. The use of these Charts is described below and on page 6.

INDIVIDUAL PROGRESS REPORT

One copy should be kept in each student's confidential file and updated as tasks are completed. Grades should be assigned upon task completion and then averaged for grade reporting. Difficulty, excessive amounts of time, etc. should be noted on this form and should be discussed with the student.

GROUP PROGRESS CHART

This chart reflects task completion only and can be displayed in the classroom or lab area. Due to confidentiality of records, a grade must not be recorded. The instructor should maintain a copy of this record and update it daily.

INDIVIDUAL PROGRESS REPORT

NAME ______________________________

PROGRAM/ CLUSTER ______________________________ AREA ______________________________

TASK/ UNIT NO.	UNIT TITLE	DATE STARTED	DATE COMP.	EST. TIME	GRADE

GROUP PROGRESS CHART

NAME	UNITS/TASKS																				

COMPETENCY CHECKLIST

The Competency Checklist is an easy device for the instructor to use to know when a student is eligible to receive a Certificate of Competency (shown on page 9). One Checklist is used per student for as long as the student stays in the program. The instructor may use the checklist in the following manner:

1. Enter the student's name on the form.
2. As the student masters each task, check-off the task under each job title on the Competency Checklist for which it appears.
3. Keep the Checklist in each student's personal file or keep all Competency Checklists together in a separate file.
4. When all the tasks underneath a job title have been checked-off, the student is eligible to receive a Certificate of Competency for that job title.

CERTIFICATE OF COMPETENCY

The Certificate of Competency is issued by the instructor to certify that the student has mastered the tasks necessary for entry level employment for the job listed on the Certificate. The specific tasks that have been mastered are printed on the back of the Certificate, which can be used by the student to show a prospective employer exactly what the student is qualified to do. The Certificates should be printed ahead of time so that the instructor may simply fill in the front of the Certificate whenever a student is eligible to receive one, as indicated by the student's Competency Checklist. A sample completed Certificate of Competency appears on page 9 followed by a Certificate of Competency for each of the possible Mechanical Technology program exit points (job titles).

The Certificate should be completed by the instructor as follows:

1. Enter the student's name.
2. Enter the school name.
3. Date and sign the Certificate.
4. It is recommended that the Certificate be stamped with the school seal.

COMPETENCY CHECKLIST

____
Student Name

As the student masters each unit of instruction, check off the list number under each of the following job titles where it appears. When all the units under a job title have been completed, the student is eligible to receive a certificate of competency for that job title.

Sheet Metal Worker
804.281-010

( ) MI-11
( ) MI-12
( ) MI-13
( ) MI-14
( ) MI-15
( ) MI-16
( ) MI-17
( ) MI-18
( ) MI-19
( ) MI-20
( ) D-20
( ) D-21
( ) D-24
( ) D-25
( ) D-29
( ) MP-01
( ) MP-04
( ) MP-05
( ) MP-06
( ) MP-07
( ) MP-12
( ) MP-14
( ) MP-15
( ) MP-16
( ) MP-19
( ) MP-21
( ) MP-26
( ) MP-27
( ) MP-28
( ) MP-29
( ) MP-30
( ) MP-31
( ) MP-60
( ) MP-61
( ) MP-62
( ) MP-63
( ) MP-64
( ) MP-65
( ) MP-90
( ) MP-91
( ) MP-92
( ) MP-93
( ) MP-94
( ) MP-95
( ) MP-96
( ) MP-97
( ) MP-98
( ) MP-99

Sheet Metal Worker, Maintenance
804.281-010

( ) MP-01
( ) MP-04
( ) MP-05
( ) MP-06
( ) MP-07
( ) MP-10
( ) MP-12
( ) MP-14
( ) MP-15
( ) MP-16
( ) MP-19
( ) MP-21
( ) MP-26
( ) MP-27
( ) MP-28
( ) MP-29
( ) MP-30
( ) MP-31
( ) MP-60
( ) MP-61
( ) MP-62
( ) MP-63
( ) MP-64
( ) MP-65
( ) MP-90
( ) MP-91
( ) MP-92
( ) MP-93
( ) MP-94
( ) MP-95
( ) MP-96
( ) MP-97
( ) MP-98
( ) MP-99

Wirer
729.281-014

( ) EL-01
( ) EL-02
( ) EL-03
( ) EL-04
( ) EL-05
( ) EL-06
( ) EL-07
( ) EL-12
( ) EL-13
( ) EL-14
( ) EL-15
( ) EL-16
( ) EL-18
( ) EL-19
( ) EL-20
( ) EL-21
( ) EL-22
( ) EL-23
( ) EL-24
( ) EL-25
( ) EL-26

Assembly Technician
633.261-010

( ) MI-01
( ) MI-02
( ) MI-03
( ) MI-04
( ) MI-05
( ) MI-06
( ) MI-07
( ) MI-08
( ) MI-09
( ) MI-10
( ) MI-11
( ) MI-12
( ) MI-13
( ) MI-14
( ) MI-15
( ) MI-16
( ) MI-17
( ) MI-18
( ) MI-19
( ) MI-20
( ) D-01
( ) D-02
( ) D-03
( ) D-04
( ) D-05
( ) D-06
( ) D-07
( ) D-08
( ) D-09
( ) D-10
( ) D-11
( ) D-12
( ) D-13
( ) D-14
( ) D-15
( ) D-16
( ) D-17
( ) D-18
( ) D-19
( ) D-20
( ) D-21
( ) D-22
( ) D-23
( ) D-24
( ) D-25
( ) D-26
( ) D-27
( ) D-28
( ) D-29
( ) MP-01
( ) MP-02
( ) MP-03
( ) MP-04
( ) MP-05
( ) MP-06
( ) MP-07
( ) MP-08
( ) MP-09
( ) MP-10
( ) MP-11
( ) MP-12
( ) MP-13
( ) MP-14
( ) MP-15
( ) MP-16
( ) MP-17
( ) MP-18
( ) MP-19
( ) MP-20
( ) MP-21
( ) MP-22
( ) MP-23
( ) MP-24
( ) MP-25
( ) MP-26
( ) MP-27
( ) MP-28
( ) MP-29
( ) MP-30
( ) MP-31
( ) MP-32
( ) MP-33
( ) MP-34
( ) MP-35
( ) MP-36
( ) MP-37
( ) MP-38
( ) MP-39
( ) MP-40
( ) MP-41
( ) MP-42
( ) MP-43
( ) MP-44
( ) MP-45
( ) MP-46
( ) MP-47
( ) MP-48
( ) MP-49
( ) MP-50
( ) MP-51
( ) MP-52
( ) MP-53
( ) MP-54
( ) MP-55
( ) MP-56
( ) MP-57
( ) MP-58
( ) MP-59
( ) MP-60
( ) MP-61
( ) MP-62
( ) MP-63
( ) MP-64
( ) MP-65
( ) MP-66
( ) MP-67
( ) MP-68
( ) MP-69
( ) MP-70
( ) MP-71
( ) MP-72
( ) MP-73
( ) MP-74
( ) MP-75
( ) MP-76
( ) MP-77
( ) MP-78
( ) MP-79
( ) MP-80
( ) MP-81
( ) MP-82
( ) MP-83
( ) MP-84
( ) MP-85
( ) MP-86
( ) MP-87
( ) MP-88
( ) MP-89
( ) MP-90
( ) MP-91
( ) MP-92
( ) MP-93
( ) MP-94
( ) MP-95
( ) MP-96
( ) MP-97
( ) MP-98
( ) MP-99
( ) MD-01
( ) MD-02
( ) MD-03
( ) MD-04
( ) MD-05
( ) MD-06
( ) MD-07
( ) MD-08
( ) MD-09
( ) MD-10
( ) MD-11
( ) MD-12
( ) MD-13
( ) MD-14
( ) MD-15
( ) MD-16
( ) MD-17
( ) MD-18
( ) FP-01
( ) FP-02
( ) FP-03
( ) FP-04
( ) FP-05
( ) FP-06
( ) FP-07
( ) FP-08
( ) FP-09
( ) FP-10
( ) FP-11
( ) FP-12
( ) FP-13
( ) FP-14
( ) FP-15
( ) FP-16
( ) FP-17
( ) FP-18
( ) FP-19
( ) FP-20
( ) EL-01
( ) EL-02
( ) EL-03
( ) EL-04
( ) EL-05
( ) EL-06
( ) EL-07
( ) EL-08
( ) EL-09
( ) EL-10
( ) EL-11
( ) EL-12
( ) EL-13
( ) EL-14
( ) EL-15
( ) EL-16
( ) EL-17
( ) EL-18
( ) EL-19
( ) EL-20
( ) EL-21
( ) EL-22
( ) EL-23
( ) EL-24
( ) EL-25
( ) EL-26

Electrical Repairer
829.281-014

( ) EL-01
( ) EL-02
( ) EL-03
( ) EL-04
( ) EL-05
( ) EL-06
( ) EL-07
( ) EL-08
( ) EL-09
( ) EL-10
( ) EL-11
( ) EL-12
( ) EL-13
( ) EL-14
( ) EL-15
( ) EL-16
( ) EL-17
( ) EL-18
( ) EL-19
( ) EL-20
( ) EL-21
( ) EL-22
( ) EL-23
( ) EL-24
( ) EL-25
( ) EL-26

Electronics Assembler
726.684-018

( ) EL-01
( ) EL-02
( ) EL-03
( ) EL-04
( ) EL-05
( ) EL-06
( ) EL-17

Electronics Mechanic
828.281-010

( ) EL-01
( ) EL-02
( ) EL-03
( ) EL-04
( ) EL-05
( ) EL-06
( ) EL-07
( ) EL-08
( ) EL-17
( ) EL-18
( ) EL-19
( ) EL-20
( ) EL-21
( ) EL-22
( ) EL-23
( ) EL-24
( ) EL-25
( ) EL-26

Electronics Utility Worker
726.361-010

( ) EL-01
( ) EL-02
( ) EL-03
( ) EL-04
( ) EL-05
( ) EL-06
( ) EL-18
( ) EL-19
( ) EL-20
( ) EL-21
( ) EL-22
( ) EL-23
( ) EL-24
( ) EL-25
( ) EL-26

CERTIFICATE OF COMPETENCY

This is to Certify that

Ken Adams

of

Pickens Area Tech School

SAMPLE

has successfully mastered the competencies required to perform the job of

WIRER

Donald F. Huggins

July 30, 1981

The student named on this certificate has demonstrated mastery of the following tasks required to perform the job of Wirer.

WIRER
729.281-014

Defining terminology and analyzing theory associated with basic D.C. circuits
Defining and converting electrical units associated with basic D.C. and A.C. circuits
Calculating basic D.C. series circuits
Calculating basic D.C. parallel circuits
Calculating basic D.C. series parallel circuits
Defining terminology and analyzing theory associated with basic A.C. circuits
Calculating power factors, impedance and pure resistance in series A.C. circuits
Applying basic A.C. circuit theory when drawing residential cable layouts from engineering sketches
Applying basic A.C. circuit theory when drawing commercial cable layouts from engineering sketches
Drawing electrical one-line diagrams from engineering sketches
Drawing electrical elementary diagrams from engineering sketches
Drawing electronic schematic diagrams from engineering sketches
Planning and performing site work for a small industrial facility
Making calculations for electric motors, welders and heaters
Selecting the correct transformer bank
Operating a split phase motor
Operating a capacitor start motor
Operating a universal motor
Operating an induction regulator
Operating a rotary frequency changer
Operating a rotary converter

CERTIFICATE OF COMPETENCY

This is to Certify that

____

of

____

has successfully mastered the competencies required to perform the job of

SHEET METAL WORKER

____

____

The student named on this certificate has demonstrated mastery of the following tasks required to perform the job of Sheet Metal Worker.

SHEET METAL WORKER
804.281-010

Identifying the physical structure of metals
Identifying properties of metals
Identiyfing methods of heat treatment
Identifying metal manufacturing processes
Identifying iron manufacturing processes
Identifying processes used to produce steel
Identifying processes used to produce aluminum
Identifying processes for the production of magnesium and titanium
Identifying processes used to produce copper
Identifying processes used to produce lead, nickel, tin and zinc
Drawing welds
Dimensioning tolerances
Drawing details
Drawing assemblies
Drawing sections
Laying out metal surfaces
Using the bevel protractor
Using steel rules
Using the micrometer
Reading on Vernier scale
Identifying and using files
Using hammers and screwdrivers for hand bench use
Identifying and using wrenches
Using bench vices and clamps
Identifying power tool safety practices
Identifying fasteners
Identifying parts and functions of the drilling machine
Identifying safety practices and precautions when using the drilling machine
Identifying work holding devices and set ups
Identifying and using drill bit holding devices
Identifying drill bits
Identifying cutting feeds and speeds
Identifying power cut-off saws
Identifying power saw safety
Identifying and using work holding devices on the power cut-off saw
Identifying, selecting, mounting and maintaining saw blades
Identifying speeds, feeds and coolants for power cut-off saws
Using the power cut-off saw for straight and angular sawing
Identifying materials used in sheet metalwork
Developing sheet metal patterns (stretchouts)
Cutting sheet metal
Bending sheet metal by hand
Bending metal on a bar folder or brake
Roll-forming sheet metal
Making seams
Using the rotary machine
Fastening sheet metal
Soft soldering sheet metal

CERTIFICATE OF COMPETENCY

This is to Certify that

____

of

____

has successfully mastered the competencies required to perform the job of

SHEET METAL WORKER, MAINTENANCE

____

____

The student named on this certificate has demonstrated mastery of the following tasks required to perform the job of Sheet Metal Worker, Maintenance.

SHEET METAL WORKER, MAINTENANCE
804.281-010

Laying out metal surfaces
Using the bevel protractor
Using steel rules
Using the micrometer
Reading on Vernier scale
Identifying and using hand hacksaws
Identifying and using files
Using hammers and screwdrivers for hand bench use
Identifying and using wrenches
Using bench vices and clamps
Identifying power tool safety practices
Identifying fasteners
Identifying parts and functions of the drilling machine
Identifying safety practices and precautions when using the drilling machine
Identifying work holding devices and set ups
Identifying and using drill bit holding devices
Identifying drill bits
Identifying cutting feeds and speeds
Identifying power cut-off saws
Identifying power saw safety
Identifying and using work holding devices on the power cut-off saw
Identifying, selecting, mounting and maintaining saw blades
Identifying speeds, feeds and coolants for power cut-off saws
Using the power cut-off saw for straight and angular sawing
Identifying materials used in sheet metalwork
Developing sheet metal patterns (stretchouts)
Cutting sheet metal
Bending sheet metal by hand
Bending metal on a bar folder or brake
Roll-forming sheet metal
Making seams
Using the rotary machine
Fastening sheet metal
Soft soldering sheet metal

CERTIFICATE OF COMPETENCY

This is to Certify that

____

of

____

has successfully mastered the competencies required to perform the job of

ASSEMBLY TECHNICIAN

____

____

The student named on this certificate has demonstrated mastery of the following tasks required to perform the job of Assembly Technician.

ASSEMBLY TECHNICIAN
633.261-010

- Identifying non-metal materials
- Identifying properties of plastics
- Identifying properties of rubber
- Identifying properties and applications of carbon
- Identifying industrial chemicals and their applications
- Identifying paints, coatings and their applications
- Identifying insulating materials and their applications
- Identifying properties and applications of construction materials
- Identifying properties and applications of wood
- Identifying adhesives and tapes
- Identifying the physical structure of metals
- Identifying properties of metals
- Identifying methods of heat treatment
- Identifying metal manufacturing processes
- Identifying iron manufacturing processes
- Identifying processes used to produce steel
- Identifying processes used to produce aluminum
- Identifying processes for the production of magnesium and titanium
- Identifying processes used to produce copper
- Identifying processes used to produce lead, nickel, tin and zinc
- Lettering by hand
- Freehand sketching
- Analyzing drawings for acceptable drafting practices
- Drawing plane figures
- Drawing with line contrast
- Drawing to scale
- Drawing in orthographic
- Dimensioning
- Drawing in isometric
- Drawing auxiliary views
- Drawing fundamental views
- Connecting skew lines
- Finding piercing points
- Drawing plane intersections
- Determining dihedral angles
- Determining true length with revolution
- Drawing intersecting solids
- Drawing developments
- Drawing fasteners
- Drawing welds
- Dimensioning tolerances
- Drawing gears
- Drawing cams
- Drawing details
- Drawing assemblies
- Drawing charts
- Drawing graphs
- Sketching designs
- Drawing sections
- Laying out metal surfaces
- Identifying jig buttons
- Using the sine bar
- Using the bevel protractor
- Using steel rules
- Identifying speeds, feeds and coolants for power cut-off saws
- Using the power cut-off saw for straight and angular sawing
- Identifying types, sizes, construction, specifications, nomenclature and range of work for shapers
- Identifying shaper work holding devices and their functions
- Identifying shaper cutting tools, grinding them to attaching to machine
- Setting up the shaper and calculating speed and feed
- Adjusting the shaper
- Performing a horizontal shaping operation
- Performing a vertical shaping operation
- Identifying types, sizes, construction, specifications, nomenclature and range of work for planers
- Identifying and using work holding and clamping devices
- Identifying planer cutting tools, grinding them and attaching to machine
- Setting up the planer and calculating speed and feed
- Performing planing operations
- Maintaining and caring for the planer
- Identifying types, sizes, construction, specifications, nomenclature and range of work for milling machines
- Identifying milling machine work holding devices and their function
- Identifying, selecting and aligning milling machine attachments
- Selecting and setting up milling machine cutters and holders
- Calculating cutting speeds and feeds for milling machine work
- Performing a plain milling operation
- Identifying types of gears and their functions
- Identifying gear tooth elements and their symbols
- Calculating the pitch, diameters, working depth and clearances for machining gears
- Identifying grinders, grinding wheels and attachments
- Using the bench grinder
- Identifying materials used in sheet metalwork
- Developing sheet metal patterns (stretchouts)
- Cutting sheet metal
- Bending sheet metal by hand
- Bending metal on a bar folder or brake
- Roll-forming sheet metal
- Making seams
- Using the rotary machine
- Fastening sheet metal
- Soft soldering sheet metal
- Transforming units
- Calculating resultant force
- Calculating forces in static systems
- Calculating stress
- Calculating strain
- Calculating deformation
- Calculating restoring force
- Designing area of materials under stress
- Calculating frictional forces
- Calculating mass
- Describing motion on one dimension
- Describing motion resulting from forces

CERTIFICATE OF COMPETENCY

This is to Certify that

of

has successfully mastered the competencies required to perform the job of

ELECTRICAL REPAIRER

The student named on this certificate has demonstrated mastery of the following tasks required to perform the job of Electrical Repairer.

ELECTRICAL REPAIRER
829.281-014

Defining terminology and analyzing theory associated with basic D.C. circuits
Defining and converting electrical units associated with basic D.C. and A.C. circuits
Calculating basic D.C. series circuits
Calculating basic D.C. parallel circuits
Calculating basic D.C. series parallel circuits
Defining terminology and analyzing theory associated with basic A.C. circuits
Calculating power factors, impedance and pure resistance in series A.C. circuits
Calculating basic series A.C. circuits with inductance reactance and resistance
Calculating basic series A.C. circuits with capacitive reactance and resistance
Calculating series A.C. circuits with capacitive and inductive reactance and resistance
Calculating basic impedance in parallel A.C. circuits
Applying basic A.C. circuit theory when drawing residential cable layouts from engineering sketches
Applying basic A.C. circuit theory when drawing commercial cable layouts from engineering sketches
Drawing electrical one-line diagrams from engineering sketches
Drawing electrical elementary diagrams from engineering sketches
Drawing electronic schematic diagrams from engineering sketches
Laying out, taping up and/or drawing basic printed circuit boards
Planning and performing site work for a small industrial facility
Making calculations for electric motors, welders and heaters
Selecting the correct transformer bank
Operating a split phase motor
Operating a capacitor start motor
Operating a universal motor
Operating an induction regulator
Operating a rotary frequency changer
Operating a rotary converter

Using the micrometer
Reading on Vernier scale
Using dial indicators, center testers and speed indicators
Using precision gage blocks, tapered ring, plug and snap gages
Identifying and using hand hacksaws
Using abrasives and lapping compounds
Identifying and using files
Scraping flat and curved bearing surfaces
Using hammers and screwdrivers for hand bench use
Identifying and using wrenches
Using bench vices and clamps
Identifying and using chipping tools
Using hand taps, dies and hand reamers
Identifying power tool safety practices
Assembling and fitting
Identifying fasteners
Using thread, center, fillet and radius gages
Identifying lubricants and greases
Performing machine maintenance
Identifying benchwork safety
Identifying parts and functions of the drilling machine
Identifying safety practices and precautions when using the drilling machine
Identifying work holding devices and set ups
Identifying and using drill bit holding devices
Identifying drill bits
Identifying cutting feeds and speeds
Identifying lathe safety
Identifying lathes
Identifying work holding devices
Identifying cutting tools
Identifying measuring tools
Identifying lathe attachments
Calculating cutting feeds and speeds on the lathe
Determining R.P.M.
Centering stock
Identifying principles of facing
Identifying principles of straight turning and turning to shoulders
Identifying thread cutting devices
Identifying the parts of a thread
Identifying American National thread standards
Computing American National thread form
Computing sharp V-threads formulas
Identifying acme threads
Identifying square threads
Identifying classes of fits of screw threads
Using thread gauges
Using a thread micrometer
Identifying turret lathe
Identifying turret lathe safety practices
Maintaining the turret lathe
Identifying work holding devices
Identifying chucking operations on the turret lathe
Selecting cutting speed and feed on the turret lathe
Identifying coolants and cutting compounds
Identifying power cut-off saws
Identifying power saw safety
Identifying and using work holding devices on the power cut-off saw
Identifying, selecting, mounting and maintaining saw blades

Describing motion resulting from torques
Describing motion using momentum principles
Describing motion using energy principles
Calculating work
Calculating power
Calculating efficiency
Identifying principles of hydraulics
Identifying hydraulic fluids
Identifying strainers and filters in hydraulic systems
Identifying reservoirs and accumulators in hydraulic systems
Identifying pumps on hydraulic systems
Identifying piping, tubing and fittings
Identifying directional control valves
Identifying pressure control valves
Identifying cylinders
Identifying hydraulic motors
Identifying pneumatic principles
Identifying reciprocating compressors
Identifying rotary compressors
Identifying primary air treatment in pneumatic systems
Identifying secondary air treatment methods
Identifying piping, hoses and fittings used in pneumatic systems
Identifying control valves
Identifying pressure relief valves
Identifying cylinders
Identifying motors
Defining terminology and analyzing theory associated with basic D.C. circuits
Defining and converting electrical units associated with basic D.C. and A.C. circuits
Calculating basic D.C. series circuits
Calculating basic D.C. parallel circuits
Calculating basic D.C. series parallel circuits
Defining terminology and analyzing theory associated with basic A.C. circuits
Calculating power factors, impedance and pure resistance in series A.C. circuits
Calculating basic series A.C. circuits with inductance reactance and resistance
Calculating basic series A.C. circuits with capacitive reactance and resistance
Calculating series A.C. circuits with capacitive and inductive reactance and resistance
Calculating basic impedance in parallel A.C. circuits
Applying basic A.C. circuit theory when drawing residential cable layouts from engineering sketches
Applying basic A.C. circuit theory when drawing commercial cable layouts from engineering sketches
Drawing electrical one-line diagrams from engineering sketches
Drawing electrical elementary diagrams from engineering sketches
Drawing electronic schematic diagrams from engineering sketches
Laying out, taping up and/or drawing basic printed circuit boards
Planning and performing site work for a small industrial facility
Making calculations for electric motors, welders and heaters
Selecting the correct transformer bank
Operating a split phase motor
Operating a capacitor start motor
Operating a universal motor
Operating an induction regulator
Operating a rotary frequency changer
Operating a rotary converter

CERTIFICATE OF COMPETENCY

This is to Certify that

of

has successfully mastered the competencies required to perform the job of

ELECTRONICS MECHANIC

The student named on this certificate has demonstrated mastery of the following tasks required to perform the job of Electronics Mechanic.

ELECTRONICS MECHANIC
828.281-010

Defining terminology and analyzing theory associated with basic D.C. circuits
Defining and converting electrical units associated with basic D.C. and A.C. circuits
Calculating basic D.C. series circuits
Calculating basic D.C. parallel circuits
Calculating basic D.C. series parallel circuits
Defining terminology and analyzing theory associated with basic A.C. circuits
Calculating power factors, impedance and pure resistance in series A.C. circuits
Laying out, taping up and/or drawing basic printed circuit boards
Planning and performing site work for a small industrial facility
Making calculations for electric motors, welders and heaters
Selecting the correct transformer bank
Operating a split phase motor
Operating a capacitor start motor
Operating a universal motor
Operating an induction regulator
Operating a rotary frequency changer
Operating a rotary converter

CERTIFICATE OF COMPETENCY

This is to Certify that

____

of

____

has successfully mastered the competencies required to perform the job of

ELECTRONICS ASSEMBLER

____

____

The student named on this certificate has demonstrated mastery of the following tasks required to perform the job of Electronics Assembler.

ELECTRONICS ASSEMBLER
726.684-018

Defining terminology and analyzing theory associated with basic D.C. circuits
Defining and converting electrical units associated with basic D.C. and A.C. circuits
Calculating basic D.C. series circuits
Calculating basic D.C. parallel circuits
Calculating basic D.C. series parallel circuits
Defining terminology and analyzing theory associated with basic A.C. circuits
Laying out, taping up and/or drawing basic printed circuit boards

CERTIFICATE OF COMPETENCY

This is to Certify that

____

of

____

has successfully mastered the competencies required to perform the job of

ELECTRONICS UTILITY WORKER

____

____

The student named on this certificate has demonstrated mastery of the following tasks required to perform the job of Electronics Utility Worker.

ELECTRONICS UTILITY WORKER
726.361-010

Defining terminology and analyzing theory associated with basic D.C. circuits
Defining and converting electrical units associated with basic D.C. and A.C. circuits
Calculating basic D.C. series circuits
Calculating basic D.C. parallel circuits
Calculating basic D.C. series parallel circuits
Defining terminology and analyzing theory associated with basic A.C. circuits
Planning and performing site work for a small industrial facility
Making calculations for electric motors, welders and heaters
Selecting the correct transformer bank
Operating a split phase motor
Operating a capacitor start motor
Operating a universal motor
Operating an induction regulator
Operating a rotary frequency changer
Operating a rotary converter

SECTION VIII

SPECIAL NEEDS STUDENT

WORKING WITH SPECIAL NEEDS STUDENTS

Introduction

Special needs students are those who are designated as handicapped and/or disadvantaged. The 1976 vocational education amendment defines handicapped individuals as:

> Persons who are mentally retarded, hard of hearing, deaf, speech impaired, visually handicapped, seriously emotionally disturbed, orthopedically impaired, health impaired, or persons with other specific disabilities, who by reason thereof require special education and related services and who cannot succeed in the regular vocational education programs.

In Title II of the 1976 education amendments disadvantaged persons are defined as:

> Persons (other than handicapped persons) who have academic or economic disadvantages and who require special services, assistance or programs in order to enable them to succeed in vocational education programs.

Federal legislation requires that these special people be given an opportunity to function in a regular classroom. This section provides information on how special needs students are identified and how they can be mainstreamed into regular educational environments.

Figure One presents a model depicting various activities of the process in identifying and mainstreaming special needs students. These activities are conducted at three levels: the system level, the school level and the classroom level. All three levels must work together if implementation of the process is to be effective.

Identification Of The Special Needs Student

Through a variety of pre-testing procedures, special needs students are identified and their potentials are evaluated at the

SPECIAL NEEDS MAINSTREAMING MODEL

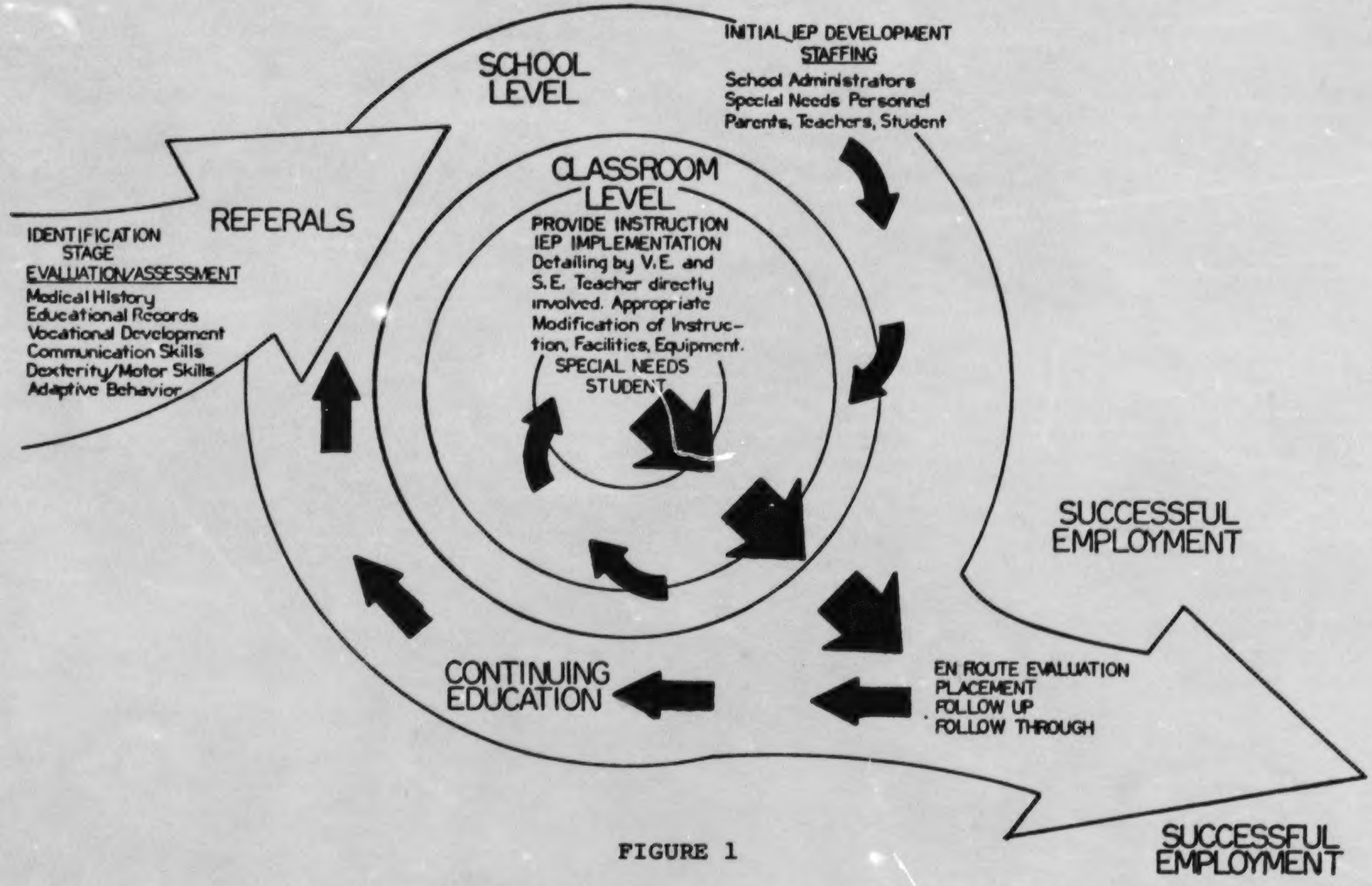

SCHOOL LEVEL
INITIAL IEP DEVELOPMENT
STAFFING
School Administrators
Special Needs Personnel
Parents, Teachers, Student
CLASSROOM LEVEL
PROVIDE INSTRUCTION
IEP IMPLEMENTATION
Detailing by V.E. and S.E. Teacher directly involved. Appropriate Modification of Instruction, Facilities, Equipment.
SPECIAL NEEDS STUDENT
REFERALS
IDENTIFICATION STAGE
EVALUATION/ASSESSMENT
Medical History
Educational Records
Vocational Development
Communication Skills
Dexterity/Motor Skills
Adaptive Behavior
SUCCESSFUL EMPLOYMENT
CONTINUING EDUCATION
EN ROUTE EVALUATION
PLACEMENT
FOLLOW UP
FOLLOW THROUGH
SUCCESSFUL EMPLOYMENT

FIGURE 1

system level. This evaluation process consists of collecting and assessing the following data for each student:

- -Medical History
- -Educational Records
- -Vocational Development
- -Communication Skills
- -Dexterity/Motor Skills
- -Adaptive Behavior

When this procedure has been completed, the system personnel refers the student to the appropriate school level personnel.

Development of the Plan

At the school level, an Individual Education Plan (IEP) is developed for each special needs student. An IEP is a written plan which describes the educational objectives, both long and short term, and the support services for a special needs student. The plan is developed by the school administration, special education personnel, teacher(s) directly involved with the student and the parent(s). In some cases, the student may help with the development.

Implementing the I.E.P.

The actual implementing of the I.E.P. begins at the classroom level. The purpose of the teacher dealing with the special needs student is to help the student set realistic goals, identify the barriers which make it difficult for the student to learn and adapt the curriculum and/or facilities with reference to the I.E.P. so the student can learn while overcoming personal barriers.

Special needs students have problems which hinder their learning. Therefore, a teacher's job becomes more complicated than when teaching "regular" students. Handicapped students may have a variety of problems - mental, physical and/or emotional.

Academically disadvantaged students may exhibit language deficiencies, reading and writing deficiencies, computational deficiencies and general educational deficiencies. Economically disadvantaged students may possess an inability to concentrate because their primary needs - food, shelter, clothing - are not adequately met due to lack of money.

By considering these problems, teachers can modify existing programs to accommodate the needs of special needs learners. Some suggestions which may prove beneficial in modifying an existing curriculum are listed below:

- Prepare instructional materials in greater detail and assign work in shorter units.
- Provide more frequent evaluation of student's progress and provide opportunities for remedial work.
- Be aware of the student's limited vocabulary.
- Be aware of the student's inability to understand abstractions and generalizations and prepare materials accordingly.
- Keep the student aware of his or her progress and make the student feel he or she can succeed.
- Use real teaching aids, live work and practical experiences whenever possible.
- Choose reading material which is at the student's level, interest and experience.
- Use constructive criticism only.
- Use peer instruction whenever possible.
- Allow the student to advance at his or her own pace.
- Use the part-to-whole learning concept in adapting materials.

Facility Modifications

In some cases, facilities, must be modified for handicapped special needs students. In general, as long as the classroom/

shop meets federal guidelines for barrier free design, extensive facility changes need not be made. For visually impaired students, for example, let the student locate in the classroom where he or she can see best even to the point of moving the desk or work station as a portable unit. In the case of orthopedically handicapped, some changes may have to be made to shop machinery to allow the student to use it. This may involve more convenient controls or special seating where the student would normally stand. In making these changes, special education expertise would be helpful.

Evaluation

Evaluation of the student's program should consist of:

-En-route evaluation (formative) to monitor the student's progress through the program.

-Summative evaluation upon completion of the program to determine job readiness.

-Follow-up after placement to determine if the student is successful on the job.

-Follow-through activities designed to identify any further training needed, which is indicated by the follow-up procedure.

Working with special needs students is much more demanding of the system, the school and the instructor. However, with their patience and understanding, special needs students can not only succeed, but in many cases excell.

RESOURCES

To aid the teacher in modifying materials for special needs categories, the following references are listed by category. These are suggested references only as a world of materials exist on this subject.

Mentally Retarded

A Curriculum Guide for Teachers of Educable Mentally Retarded. Danville, Ill.: The Interstate Printers and Publishing Co., Inc.

High, Elizabeth C., and Moyers, Kathy L. *Training Manual: Developing Pre-Vocational/Vocational Skills in Developmentally Disabled Persons.* Washington, D.C.: Job Development Laboratory, George Washington University, 1976.

Kolstoe, Oliver P. *Teaching Educable Mentally Retarded Children.* Holt, Rinehart and Winston, 1976.

Mulligan, Robert E.; Gavin, Donald and Conaley, James. *Comprehensive Career Education Curriculum Guide for the Trainable.* New Brunswick, N.J.: Rutgers Vocational-Technical Curriculum Laboratory, 1977.

Introduction to Vocations for Educable Mentally Retarded. New Jersey: New Jersey Department of Education.

State of Ohio Curriculum Guide for Moderately Retarded Learners. Columbus, Ohio: Ohio Department of Education, 1977.

Tucker, Mark M. *Learning through Curriculum Modification; A Blueprint to Teaching the Mentally Retarded.* Johnstown, PA.: Mafex Associates, Inc., 1976.

Watson, Marjorie. *Mainstreaming the Educable Mentally Retarded.* Washington, D.C., NEA, 1975.

Hearing Impaired

Alvin, Howard P. *The Evolution of an Evaluation Design for Evaluating Secondary Programs for the Deaf in Vocational Occupational-Technical Education (VOTE) Programs.* ERIC - ED 123-241.

Guidelines: Educational Planning for the Hearing Handicapped. North Carolina Public Schools. Division for Exceptional Children, North Carolina Department of Public Instruction, Raleigh, N.C., 1977.

Munson, Harold L.; Eglston, Judy Cobb and Phillips, Gordon B. Career Education for Deaf Students: An Inservice Leader's Guide. University of Rochester, College of Education, Center for the Study of Helping Services, Rochester, N.Y. 1975.

Nix, Gary W. Mainstreaming Education for Hearing Impaired Children and Youth. Grune and Stratton, 1976.

Orthopedically and Other Health

A Model Plan for a Cooperative Vocational Rehabilitation Program. Office of Human Development, Rehabilitation Services and Administration. Department of Health, Education and Welfare, Washington, D.C.

Mallix, Kalisanker and Mueller, Jim. Vocational Aids and Enhanced Productivity of the Severely Disabled. The George Washington University Rehabilitation Research and Training Center, Washington, D.C. 1975.

McCarthy, Henry and Smart, Landon. Recommendations for Enhancing Employment Prospects of Handicapped Individuals. Comps. Human Resources Center, Albertson, L. I., 1978.

Duncan, John, et al. Environmental Modifications for the Visually Impaired: A Handbook. Visual Impairment and Blindness, December 1977, p. 442-455.

Disadvantaged

Guidelines for Methods and Techniques of Teaching Disadvantaged Students. Division of Vocational Education, Virginia Polytechnic Institute and State University, Blackburg, VA.

A Handbook for Developing Programs and Services for Disadvantaged Students. Department of Vocational Education Studies, College of Education, Southern Illinois, University of Carbondale, Carbondale, Ill. 62901

By Program

Adaption of Home Economics Curricula for Special Needs. North Dakota Research Coordination Unit, State Board for Vocational Education, State Office Building, Bismarck, ND.

Auto Body: An Adaptive and Developmental Program for Special Needs Students. Vocational-Technical Curriculum Laboratory, Rutgers - The State University, New Brunswick, N.J. 1976.

Floriculture Board of Cooperative Educational Services of Nassaw County, Division of Occupational Education, Division of Special Education, Westburg, NY 1975.

Hull, Marc E., Berry, Owen J. and Clark, Donald L., *Procedures for Teaching Vocational Concepts to Students with Special Needs*. Texas A & M University, Final Report Project 62350274, June 1976.

Vocational Educational Resource Materials, A Bibliography of Materials for Handicapped and Special Education. Third edition, 1978. Wisconsin Vocational Studies Center, University of Wisconsin - Madison.

SECTION IX

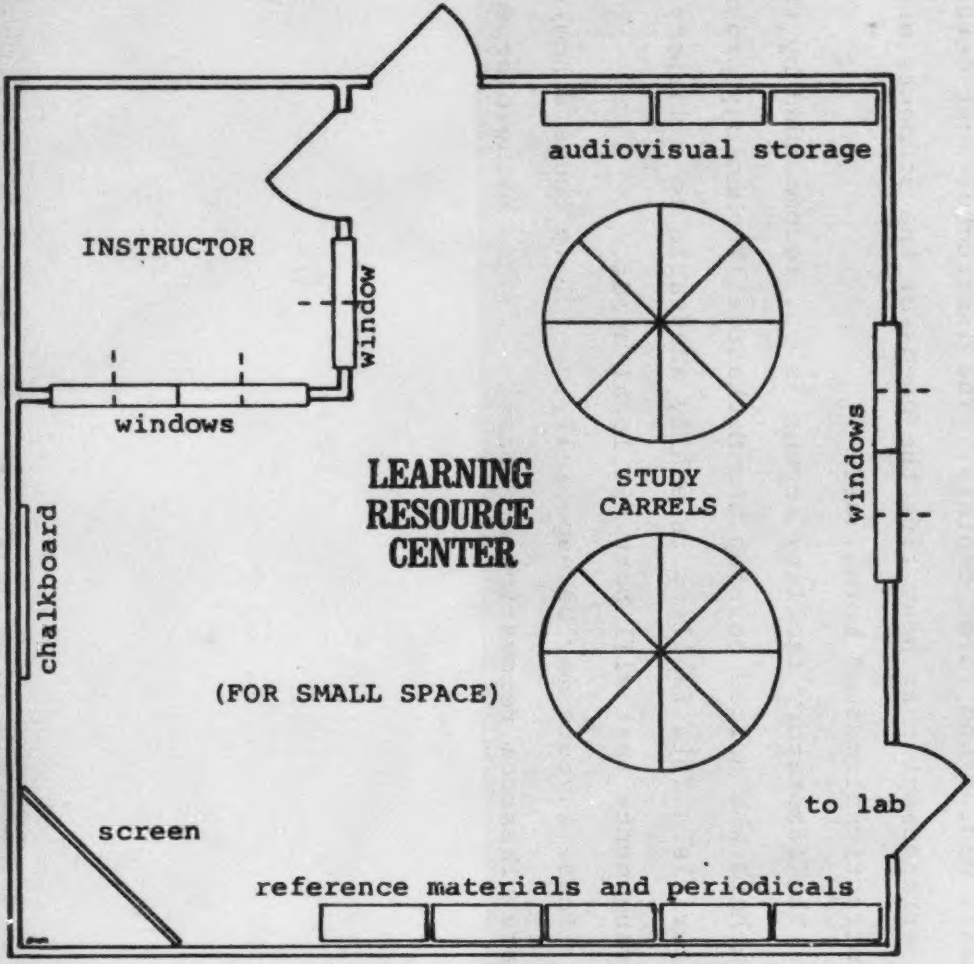
FACILITY LAYOUT

Facility Layout

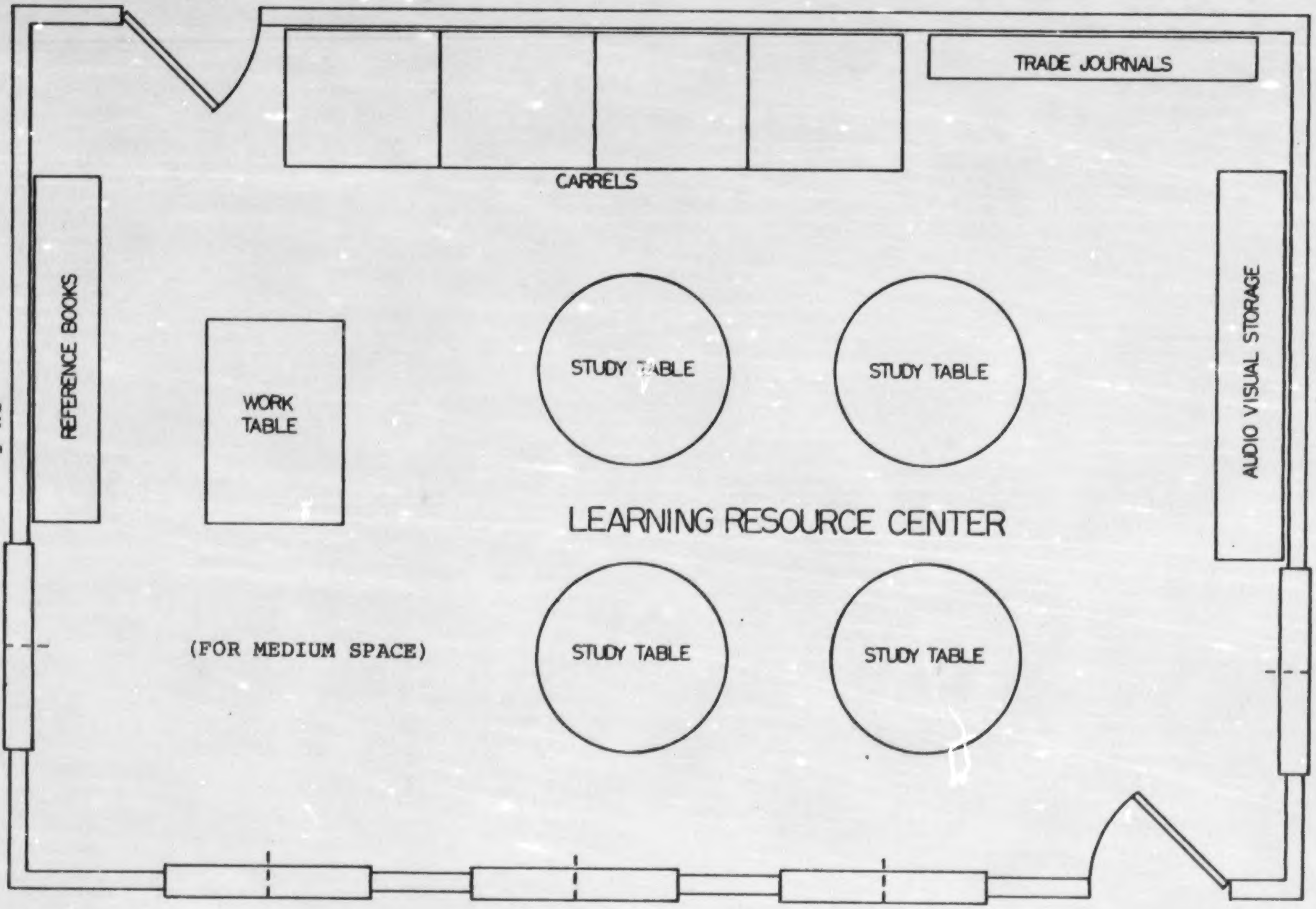
The facility layouts on the following pages are presented to aid in arranging the classroom and laboratory for efficient instruction. The three resource center arrangements represent small, medium and large centers. The instructor must determine an arrangement that best fits the needs of the students and the instructional method being used.

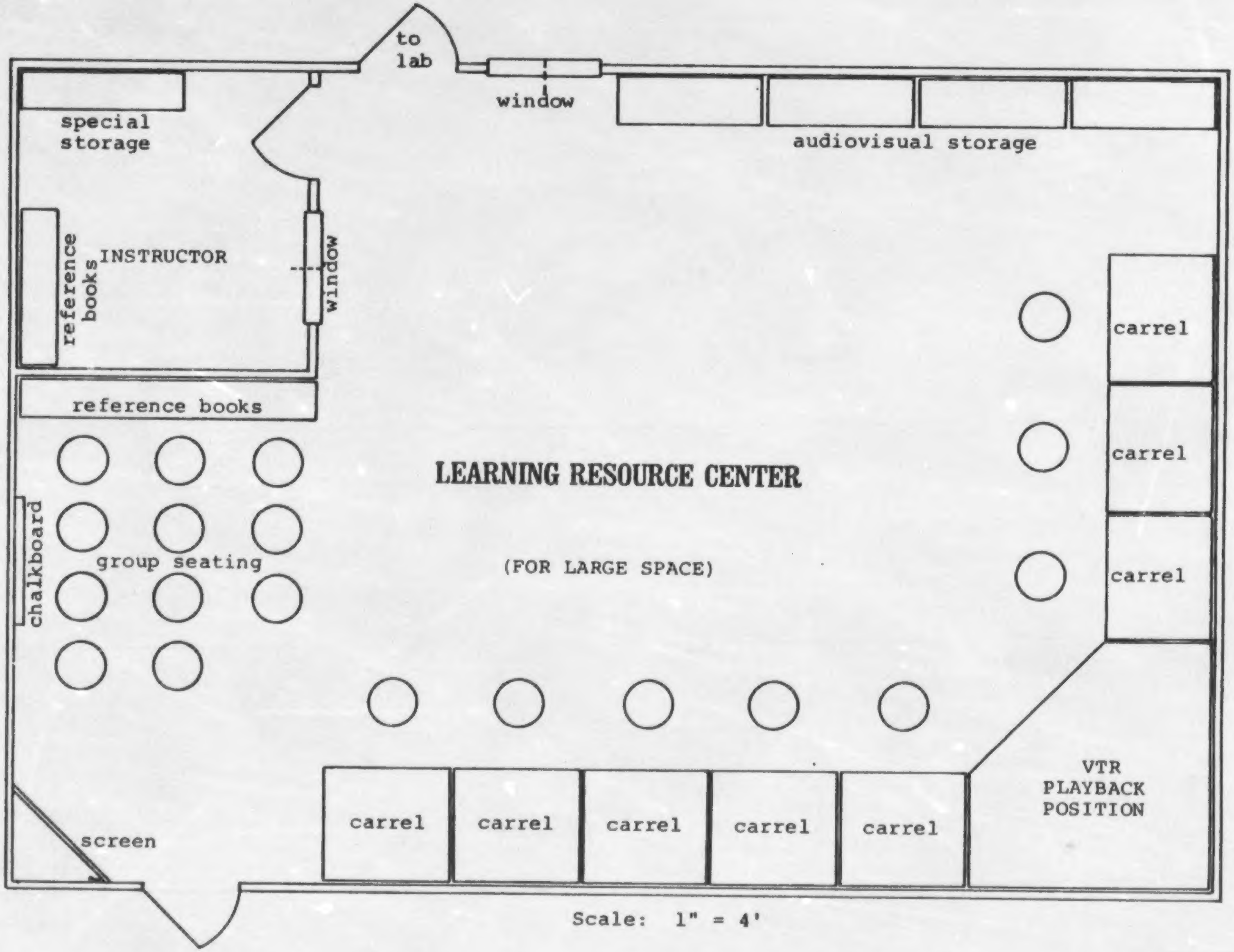
The laboratory facility layout is one recommended by the teachers who helped develop the Mechanical Technology program materials. This facility is easily adaptable to a variety of arrangements that will best fit local needs.

These layouts may be especially useful in those schools where classroom renovation or construction is being planned.


audiovisual storage
INSTRUCTOR
window
windows
LEARNING RESOURCE CENTER
STUDY CARRELS
windows
chalkboard
(FOR SMALL SPACE)
to lab
screen
reference materials and periodicals

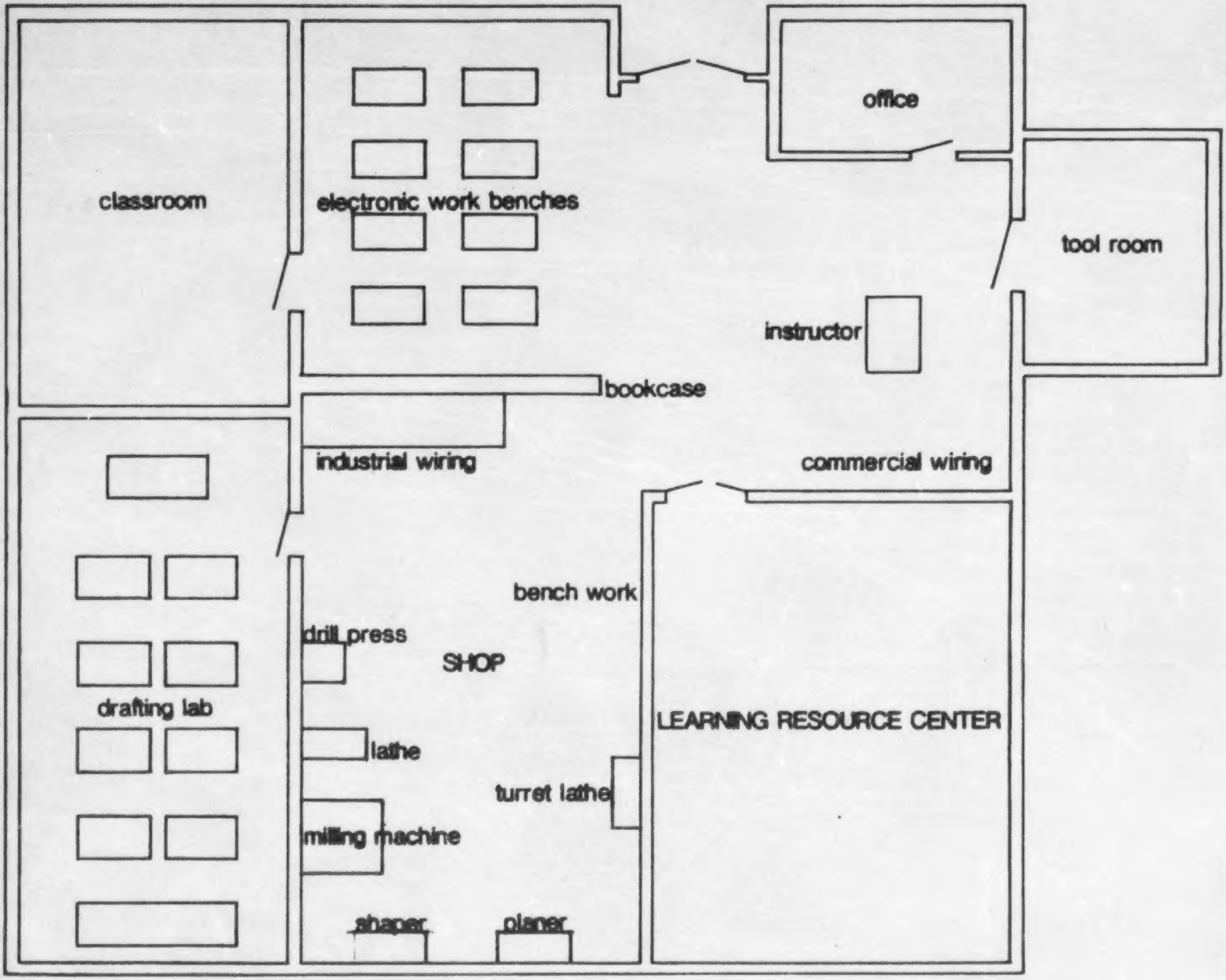
Scale: 1" = 4'


CARRELS
TRADE JOURNALS
REFERENCE BOOKS
WORK TABLE
STUDY TABLE
STUDY TABLE
LEARNING RESOURCE CENTER
STUDY TABLE
STUDY TABLE
AUDIO VISUAL STORAGE
(FOR MEDIUM SPACE)


to lab
window
special storage
audiovisual storage
reference books
INSTRUCTOR
window
reference books
carrel
carrel
carrel
LEARNING RESOURCE CENTER
(FOR LARGE SPACE)
chalkboard
group seating
VTR PLAYBACK POSITION
screen
carrel
carrel
carrel
carrel
carrel

Scale: 1" = 4'

MECHANICAL TECHNOLOGY LABORATORY


office
classroom
electronic work benches
tool room
instructor
bookcase
industrial wiring
commercial wiring
bench work
drill press
SHOP
drafting lab
LEARNING RESOURCE CENTER
lathe
turret lathe
milling machine
shaper
planer

SECTION X

DEFINITION OF TERMS

DEFINITION OF TERMS

1. AV's-Audiovisuals - May refer to any picture and/or sound media. (ie. slides, tapes, filmstrips, 16 mm films, etc.)

2. Checkpoint - A student-instructor interface point wherein the instructor may give the student a test, perform a demonstration, or simply provide the student with additional needed information or instructions. Also a checkpoint may be used for motivational purposes.

3. Competency - The ability (knowledge, skills and attitudes) to perform all of a group or cluster of related tasks required to complete a designated activity according to occupational standards. In the educational setting the statement of a competency includes expected student outcomes in terms of knowledge, skills, and attitudes required to complete a designated activity as defined by incumbent workers according to the standards of the work place.

4. Course - A grouping of tasks and competencies which have a common knowledge base or are within a given domain.

5. Criterion-Referenced Measure - An exercise based upon a performance objective, the accomplishment of which measures attainment of that objective.

6. Criterion-Referenced Test - A test designed to measure student competencies based on job or industrial standards.

7. Curriculum Guide - A document containing the objectives, content, organization, and structure of an instructional program. It is designed for use by administrators, instructional supervisors and teachers.

8. D.O.T. - Abbreviation for Dictionary of Occupational Titles. Document provides nine digit codes identifying each occupation.

9. Duty - One of the distinct major activities involved in the work performed, comprising related tasks.

10. Exit Point - A predetermined point within an instructional program in which a student may exit with the essential competencies for a specific job. Usually defined in terms of D.O.T. codes and/or O.E. codes.

11. "Hands-On" - Statement implying the student is physically involved in a learning activity.

12. Individualized Instruction (I.I.) - A system of instruction allowing for a student to progress at their fastest rate.

13. Job - A specific area of specialization within an occupational field consisting of several closely related duties for which a person would expect to receive remuneration. Should be identified by DOT code.

14. Job Sheet - (Or Operations Sheet) - A project of a performance nature. Generally performed by the student in a lab or shop type environment or in a specialized work area.

15. Live Work - Generally refers to items brought into the course area for repair or adjustment. Examples of live work might be automobiles, radios and TV's, air-conditioners, etc. Another form of live work would be patrons visiting the cosmetology department to receive permanents or other services.

16. Master Copies - Original copies of slides, tapes or written materials set aside for the purpose of duplication.

17. Occupational Cluster - A group of occupations sharing a common core of competencies. Georgia's comprehensive high school vocational program is organized around this concept.

18. Occupational Inventory - A listing of tasks to be performed in a particular occupational area, grouped under duty classifications.

19. O.E. - Refers to the U. S. Office of Education. O.E. codes are a classification system (taxonomy) for occupational education programs.

20. Open Entry - Term meaning that a student may enter the program at any time and does not have to wait for quarter or semester breaks.

21. Open Exit - Term meaning that a student may leave a program any time he/she completes their occupational objective.

22. Performance Guide - A series of steps, arranged in a sequence ordinarily followed, which when completed may result in the performance of a task. Also called "teaching steps."

23. Performance Objective - A statement in precise, measurable terms of a particular behavior to be exhibited by a learner under specified conditions. It possesses each of the elements or characteristics specified below:

    a. Condition - The testing situation confronting the learner is clearly specified. This includes equipment provided or withheld, environmental constraints such as temperature, space, etc.

b. Performance - The specific behavior expected of the learner is stated.

c. Standard - The degree of acceptable performance is specified.

24. Performance Test - A test entailing not only the ability to answer questions, but measuring the students' ability to operate, manipulate, or perform a given task as well.

25. Program - An organized sequence of courses leading to an occupational objective. A program may contain one or more student exit points as defined by D.O.T. codes.

26. Program Objective - The outcome of a prescribed program of instruction. Usually expressed in terms of the occupation or job for which training is designed. D.O.T. codes are frequently used to identify program objectives or student exit points.

27. Self-Paced - Refers to a student moving through the prescribed training program at the fastest pace at which the student can meaningfully learn.

28. Sequencing - Putting any set or series of learning activities or tasks into proper order or sequence. Normally arranged from the simple to complex within groupings or blocks.

29. Software - Written or printed materials, slides, filmstrips, tapes, etc.

30. Student Manual - A document designed for use by students in a specific instructional program. It contains unit sheets, references, operational procedures or job sheets, etc.

31. Task - The smallest division of work in which a measurable output occurs. A logical and necessary step in the performance of a duty.

32. Task List - A listing of tasks performed by incumbent workers within a domain of interest. An example is a listing of all tasks performed by an automotive mechanic or by a worker in ornamental horticulture.

33. Unit - One "module" training materials; generally covering one learning task and programmed on one Unit Sheet. May cover more than one lesson.

34. Unit Guide - A curriculum guide sheet that lists a task and objective with the instructional activities, instructional materials, evaluation and approximate time required for a student to successfully complete the task.

35. V-TECS Catalog - A comprehensive collection of performance objectives, performance guides, criterion-referenced measures, and related data, organized by a job structure or career ladder within a domain of interest.

Federal law prohibits discrimination on the basis of race, color or national origin (Title VI of the Civil Rights Act of 1964); sex (Title IX of the Educational Amendments of 1972 and Title II of the Vocational Education Amendments of 1976); or handicap (Section 504 of the Rehabilitation Act of 1973) in educational programs or activities receiving federal financial assistance.

Employees, students and the general public are hereby notified that the Georgia Department of Education does not discriminate in any educational programs or activities or in employment policies.

The following individuals have been designated as the employees responsible for coordinating the department's effort to implement this nondiscriminatory policy.

Title II - Loydia Webber, Vocational Equity Coordinator
Title VI - Peyton Williams Jr., Associate Superintendent
of State Schools and Special Services
Title IX - Evelyn Rowe and Myra Tolbert, Coordinators
Section 504 - Jane Lee, Coordinator of Special Education

Inquiries concerning the application of Title II, Title VI, Title IX or Section 504 to the policies and practices of the department may be addressed to the persons listed above at the Georgia Department of Education, State Office Building, Atlanta 30334; to the Regional Office for Civil Rights, Atlanta 30323; or to the Director, Office for Civil Rights, Education Department, Washington, D.C. 20201.